US009207590B2

(12) United States Patent
Momma et al.

(10) **Patent No.: US 9,207,590 B2**

(45) **Date of Patent: Dec. 8, 2015**

(54) **FIXING APPARATUS AND IMAGE-FORMING APPARATUS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/603,936**

(22) Filed: **Jan. 23, 2015**

(65) **Prior Publication Data**

US 2015/0212465 A1 Jul. 30, 2015

(30) **Foreign Application Priority Data**

Jan. 28, 2014 (JP) 2014-012898
Mar. 17, 2014 (JP) 2014-053082

(51) **Int. Cl.**
G03G 15/20 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/2017*** (2013.01); *G03G 15/2039* (2013.01); *G03G 15/2053* (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/2017; G03G 15/2053
USPC 399/67, 328, 329, 330
See application file for complete search history.

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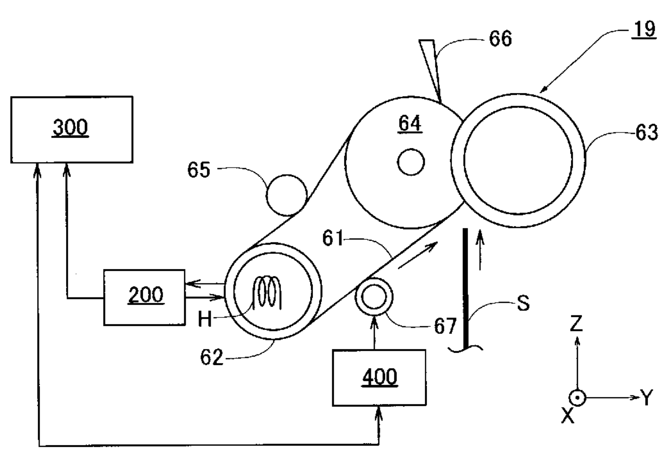
(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

A fixing apparatus for fixing a toner image borne on a sheet-like recording medium onto the sheet-like recording medium, including: a fixing member relatively moving in a first direction with respect to the sheet-like recording medium, and having a surface in contact with the toner image during a fixing operation; a surface-information-detecting device for obtaining surface information of the fixing member; a surface-condition-changing device arranged to abut on and separate from the fixing member, and abrading the surface of the fixing member in contact with the fixing member; and a surface-condition-change controller for controlling an abutting and separating of the surface-condition-changing device with respect to the fixing member according to a detection result of the surface-information-detecting device. The surface-condition-change controller controls the surface-condition-changing device according to the detection result of the surface-information-detecting device with a criteria which varies before and after the surface-condition-changing device abrades the fixing device.

9 Claims, 12 Drawing Sheets



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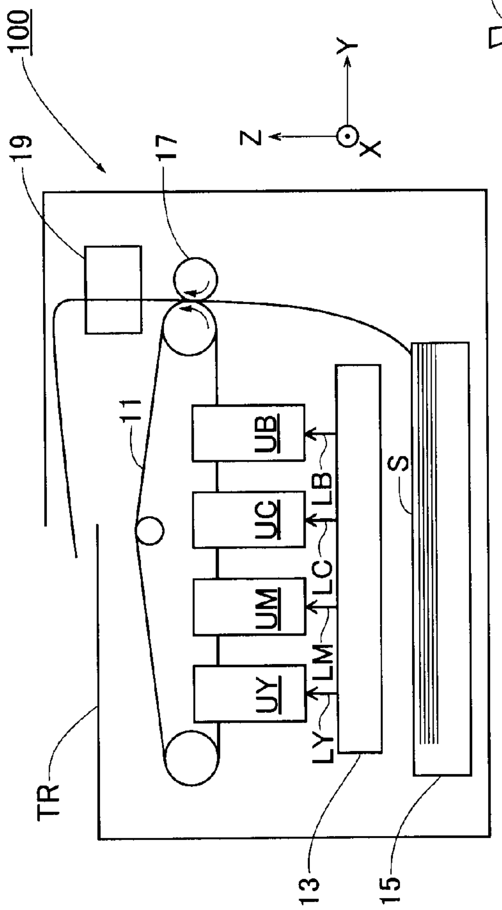


FIG.1A

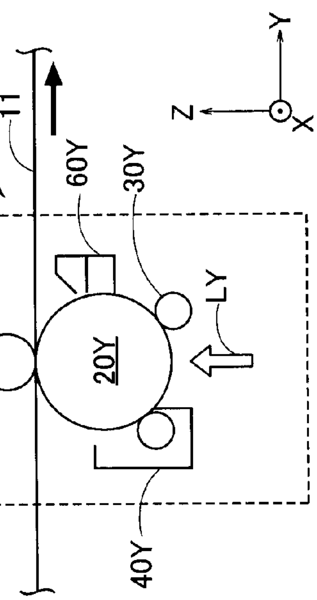


FIG.1B

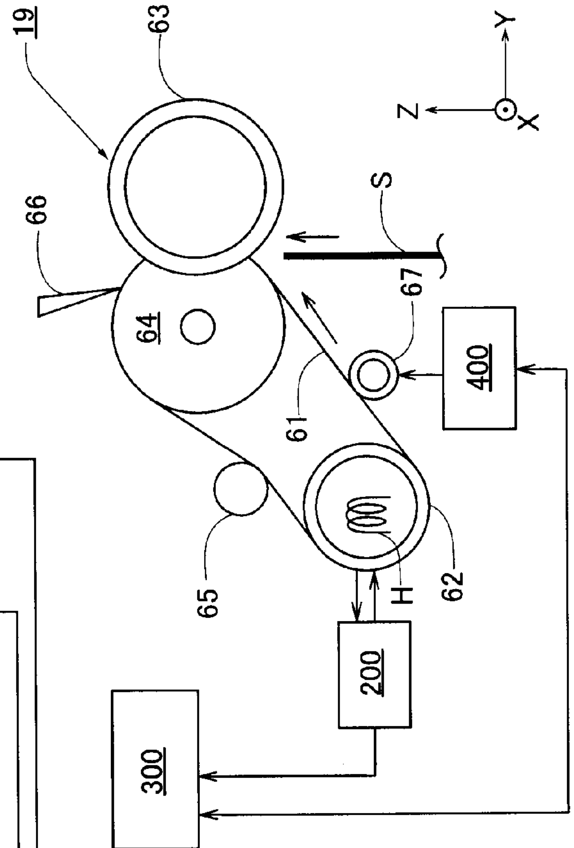


FIG.1C

FIG.2

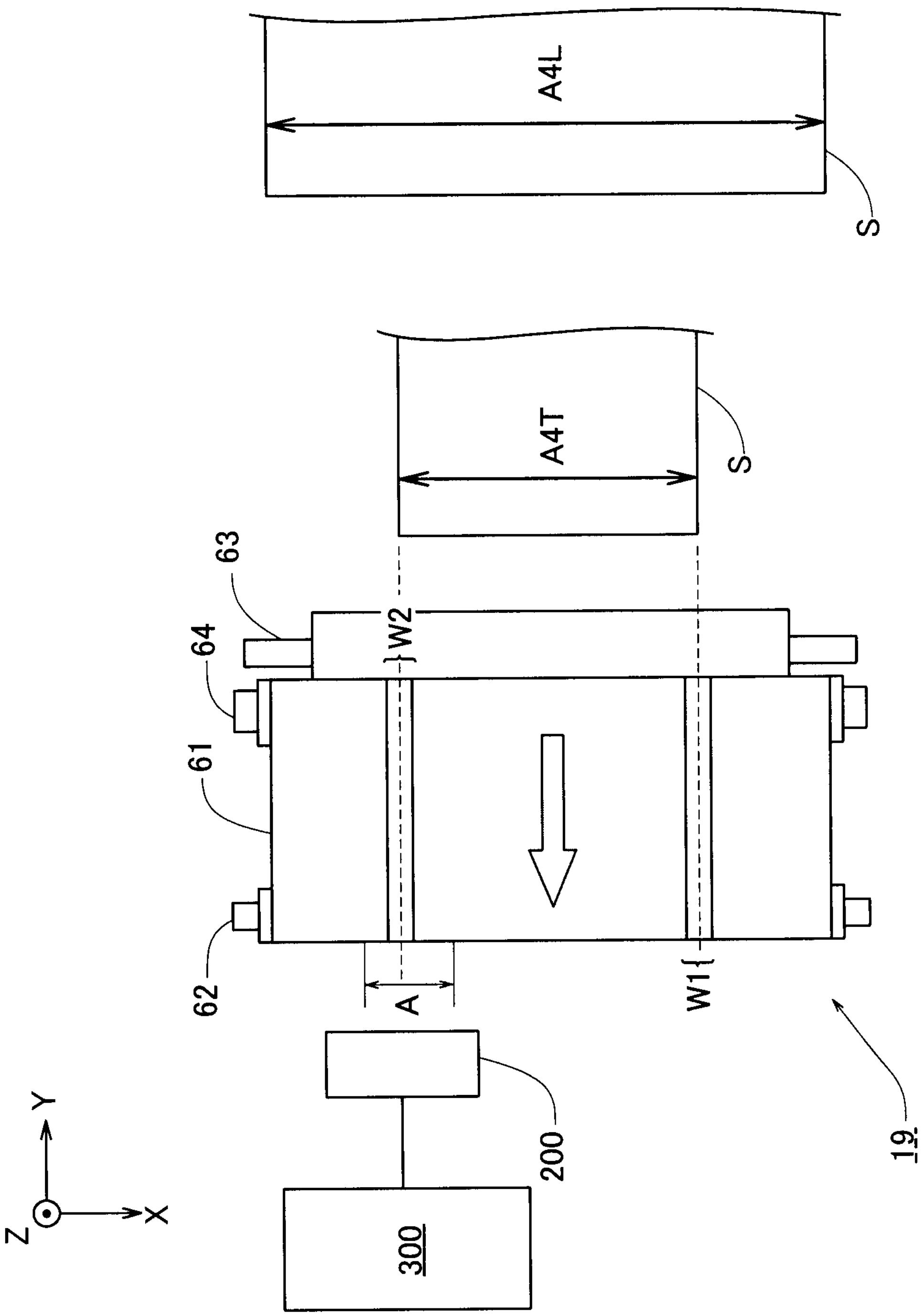


FIG.3A

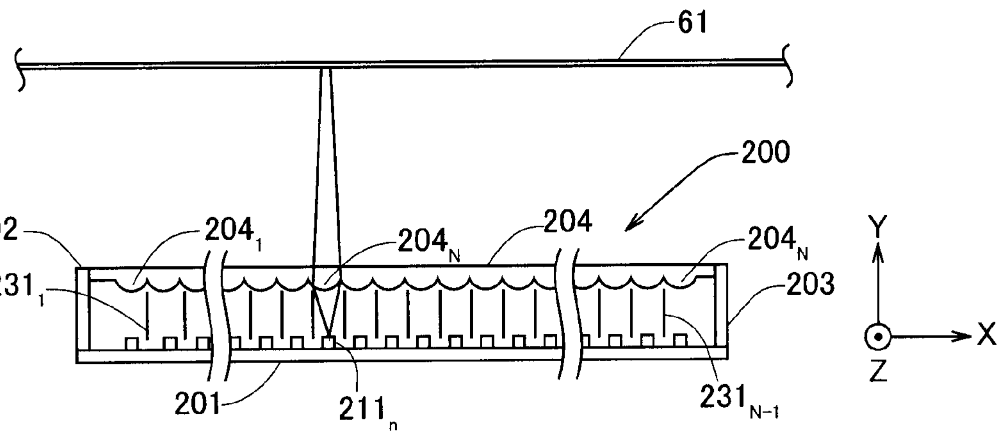


FIG.3B

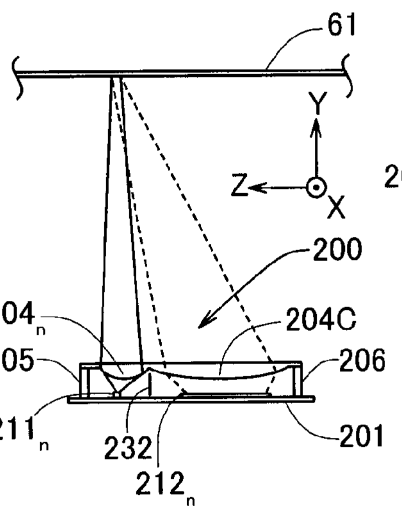


FIG.3C

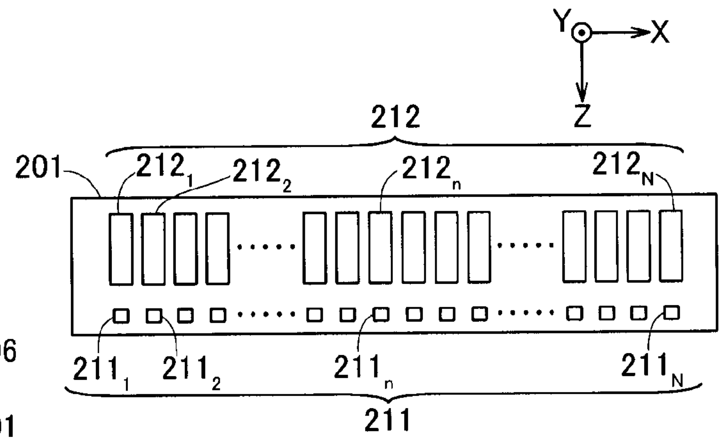


FIG.3D

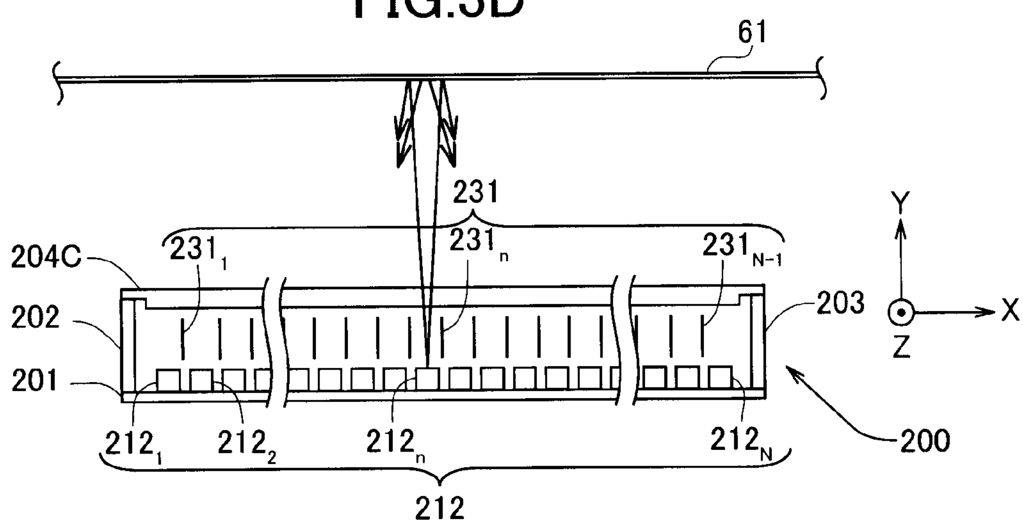


FIG.4

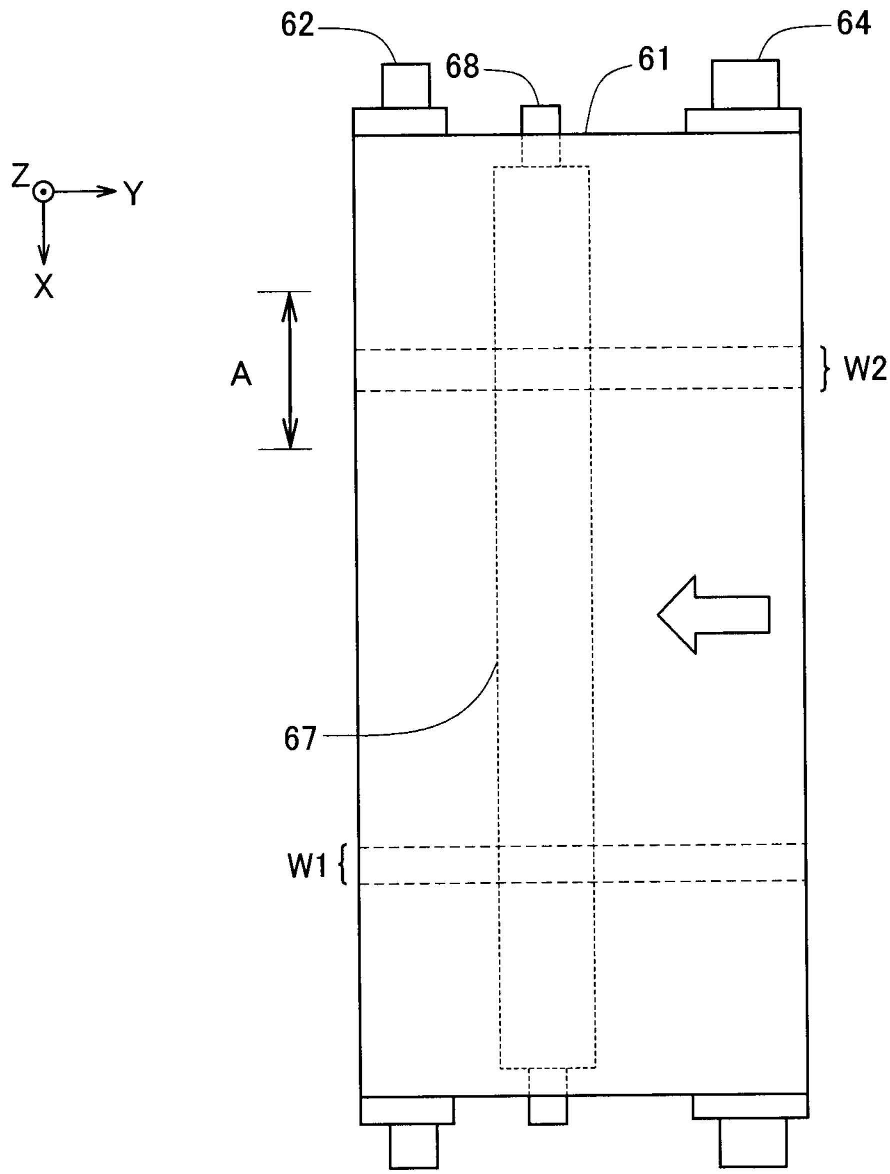


FIG.5A

ABUTTING STATE

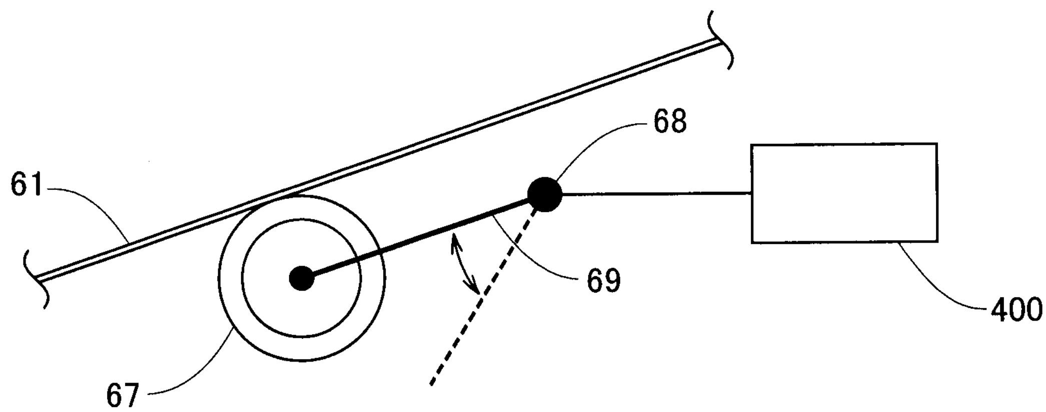


FIG.5B

SEPARATING STATE

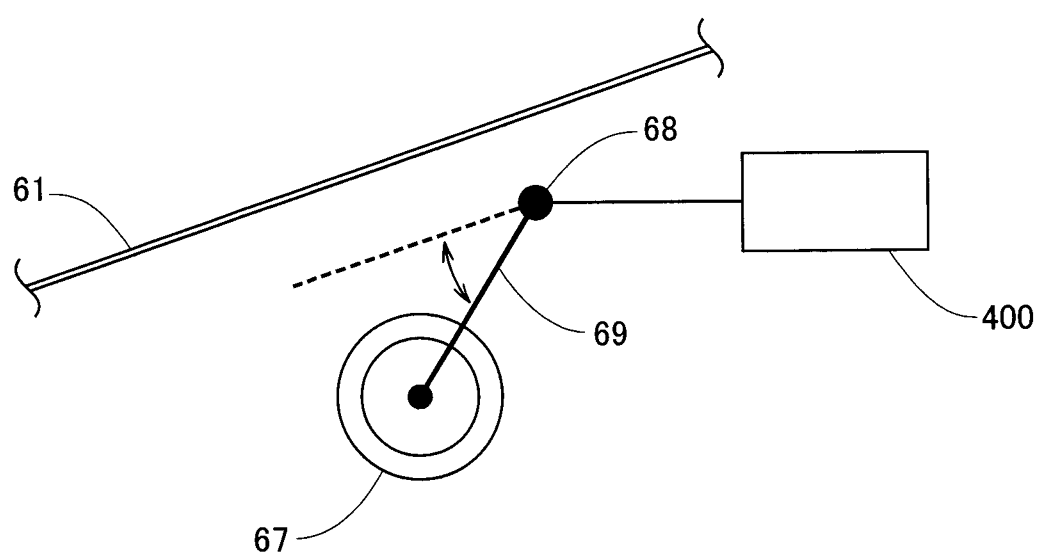


FIG.6

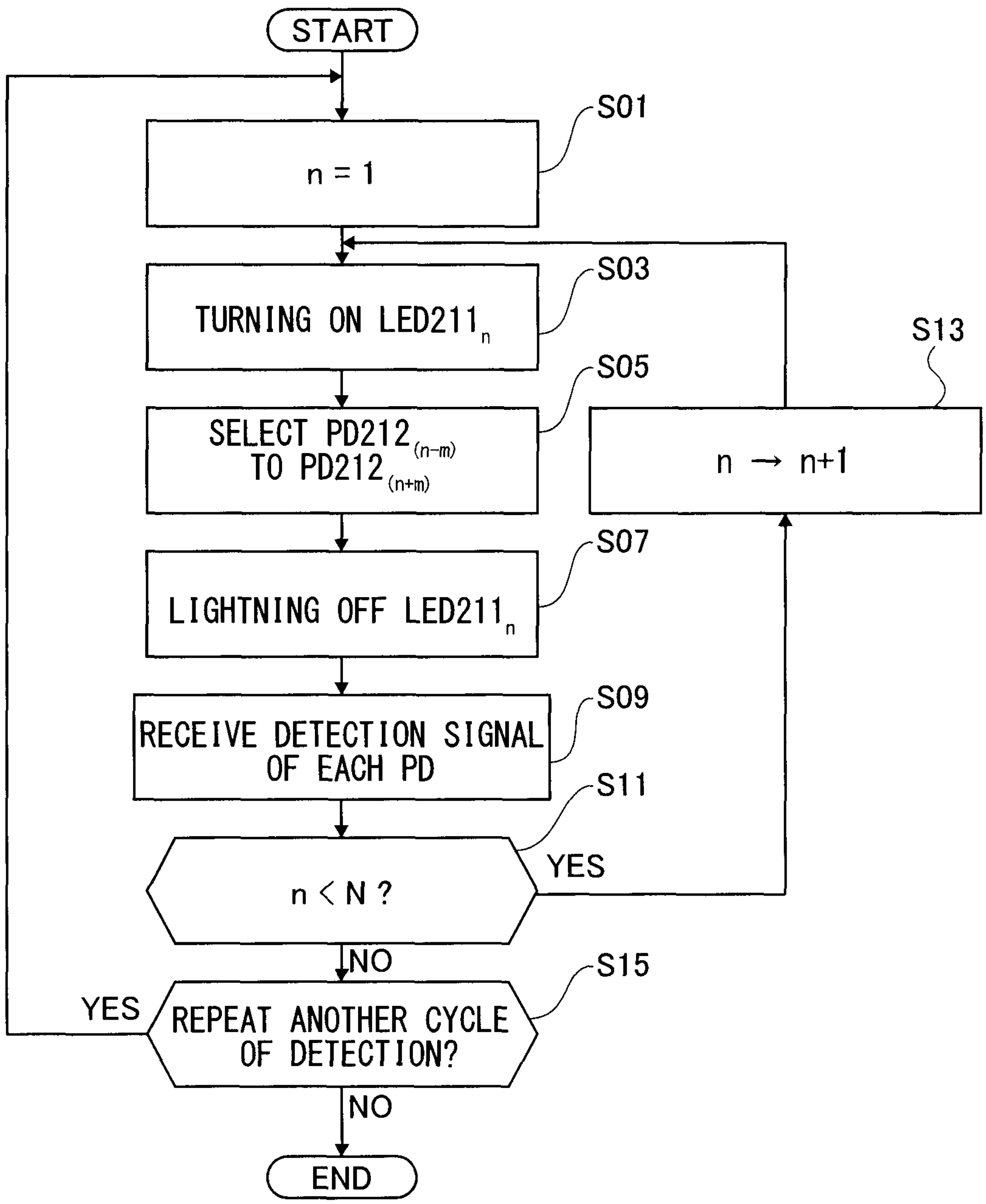

START
S01
n = 1
S03
TURNING ON LED211n
S05
SELECT PD212(n-m) TO PD212(n+m)
S13
n → n+1
S07
LIGHTNING OFF LED211n
S09
RECEIVE DETECTION SIGNAL OF EACH PD
S11
n < N ?
YES
NO
S15
YES
REPEAT ANOTHER CYCLE OF DETECTION?
NO
END

FIG.7A

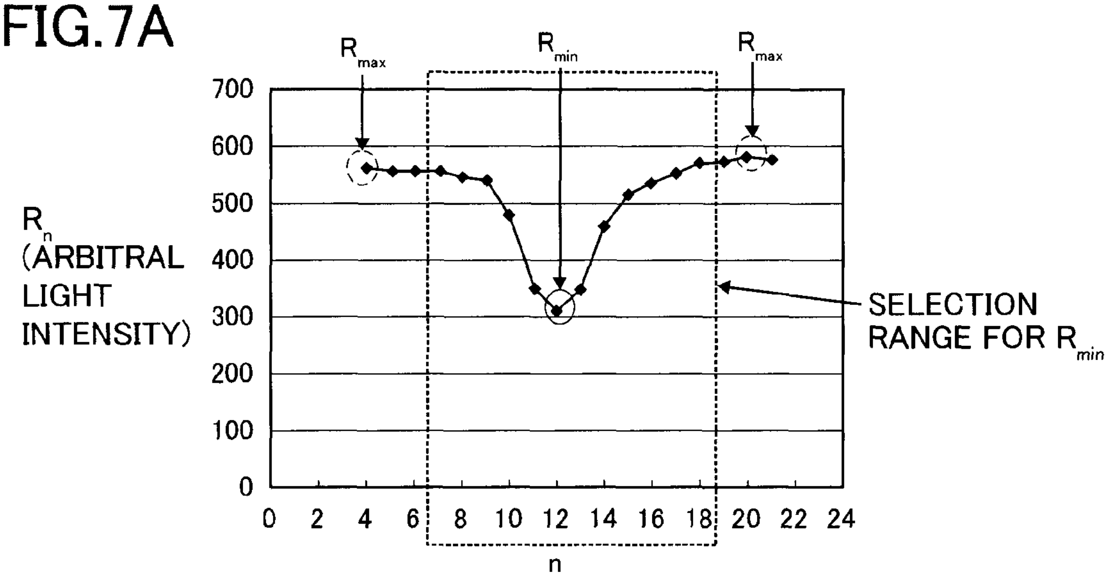


FIG.7B

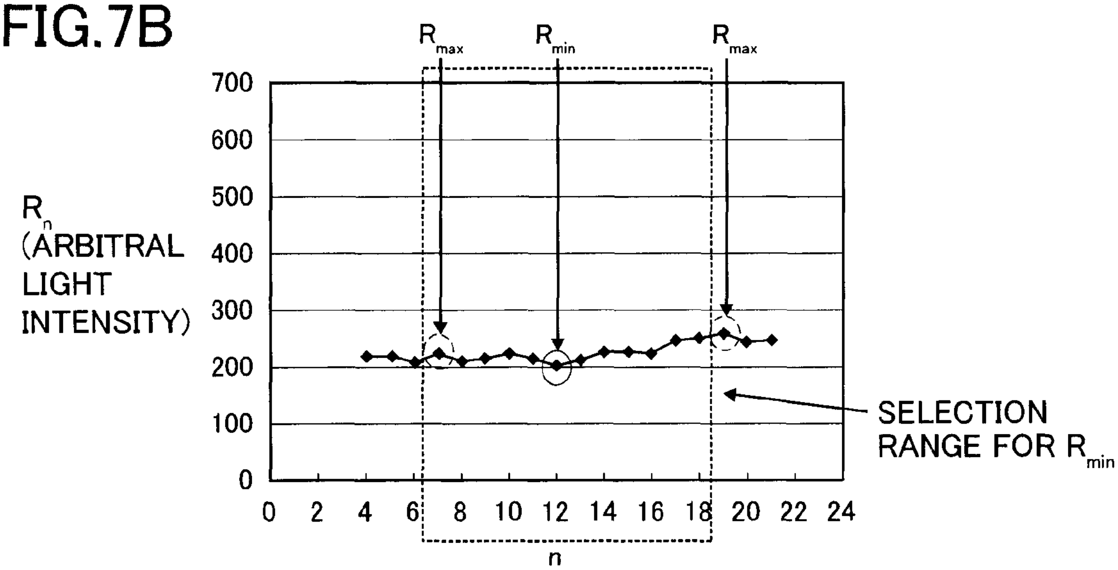


FIG.7C

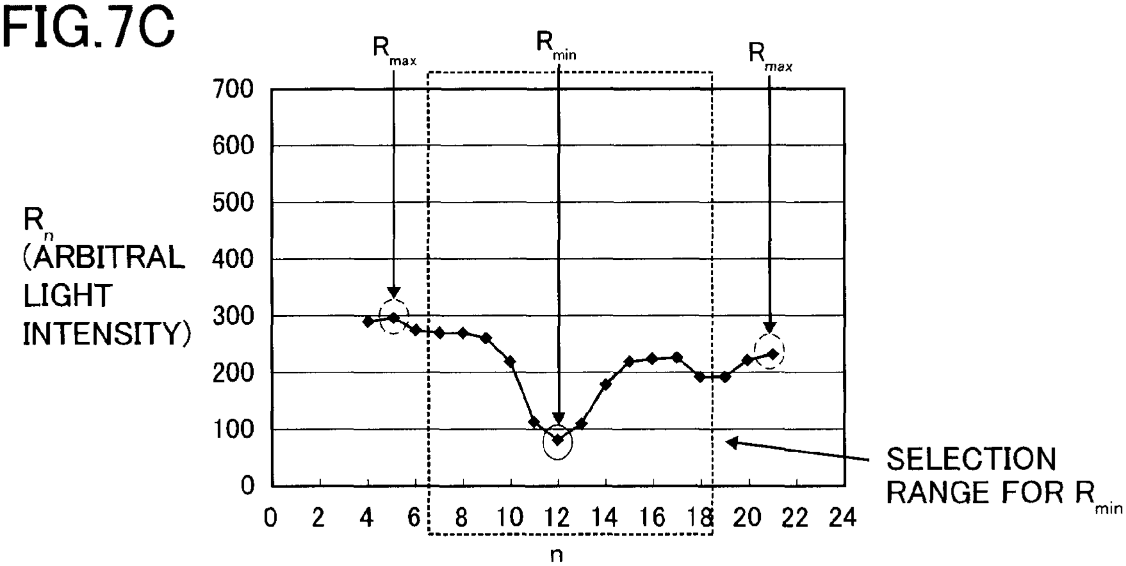


FIG.8

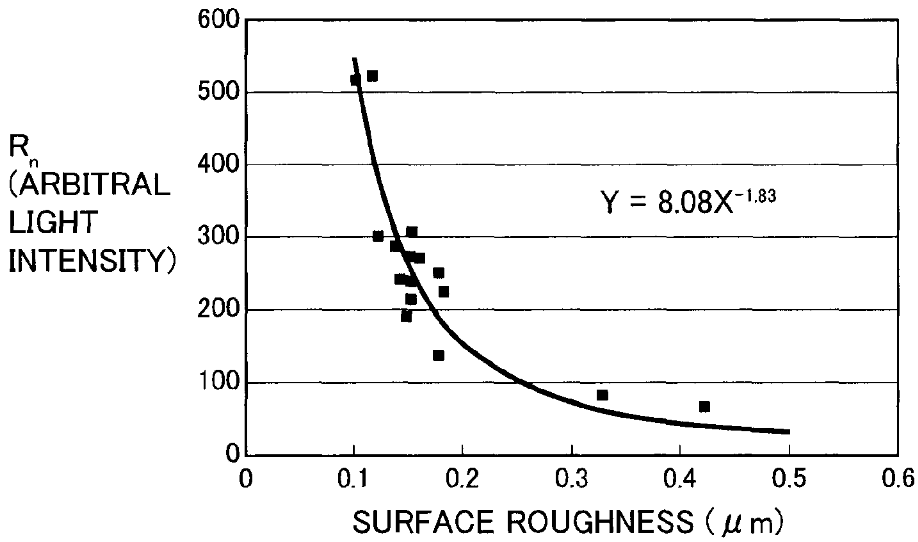

600
500
400
300
200
100
0
R_n
(ARBITRAL
LIGHT
INTENSITY)
Y = 8.08X^-1.83
0
0.1
0.2
0.3
0.4
0.5
0.6
SURFACE ROUGHNESS (μm)

FIG.9

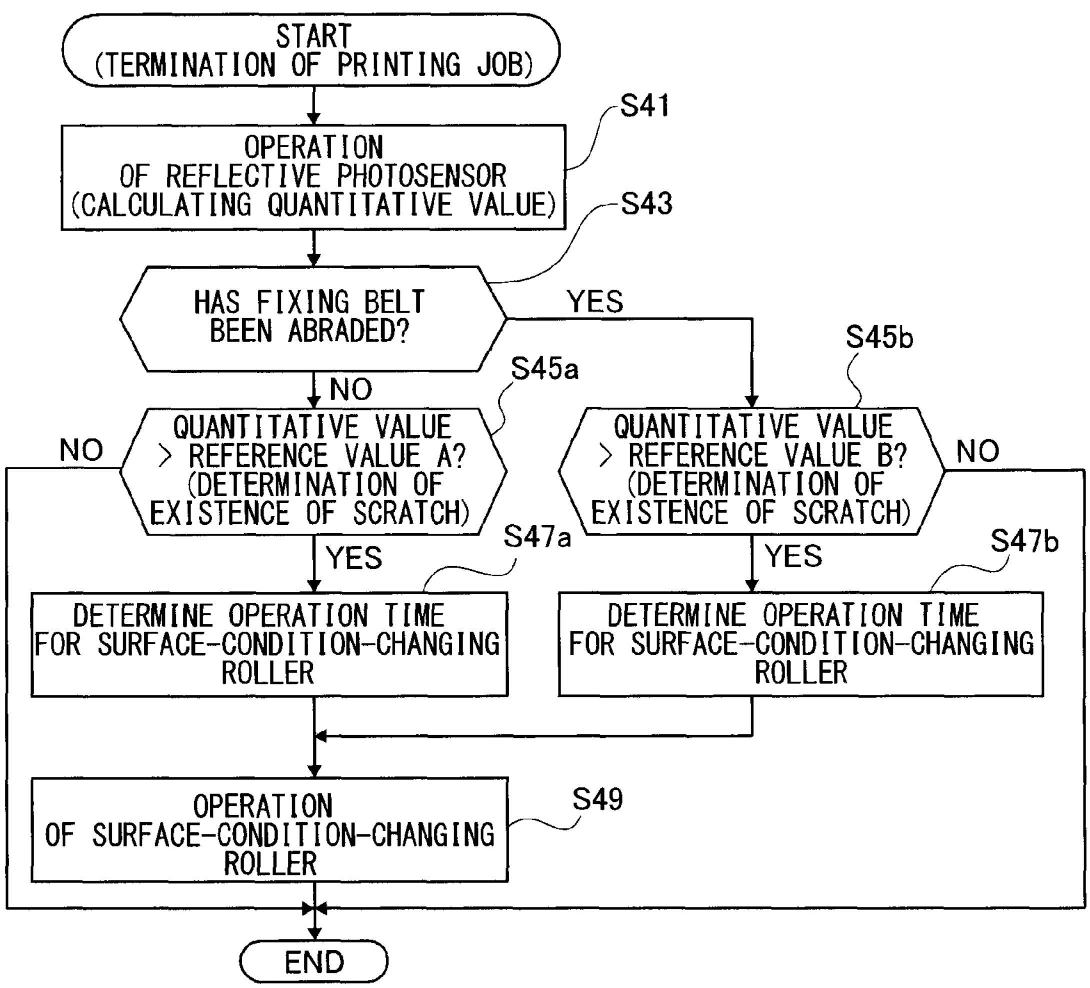

START
(TERMINATION OF PRINTING JOB)
S41
OPERATION
OF REFLECTIVE PHOTOSENSOR
(CALCULATING QUANTITATIVE VALUE)
S43
HAS FIXING BELT
BEEN ABRADED?
YES
NO
S45a
QUANTITATIVE VALUE
> REFERENCE VALUE A?
(DETERMINATION OF
EXISTENCE OF SCRATCH)
NO
YES
S45b
QUANTITATIVE VALUE
> REFERENCE VALUE B?
(DETERMINATION OF
EXISTENCE OF SCRATCH)
NO
YES
S47a
DETERMINE OPERATION TIME
FOR SURFACE-CONDITION-CHANGING
ROLLER
S47b
DETERMINE OPERATION TIME
FOR SURFACE-CONDITION-CHANGING
ROLLER
S49
OPERATION
OF SURFACE-CONDITION-CHANGING
ROLLER
END

FIG.10

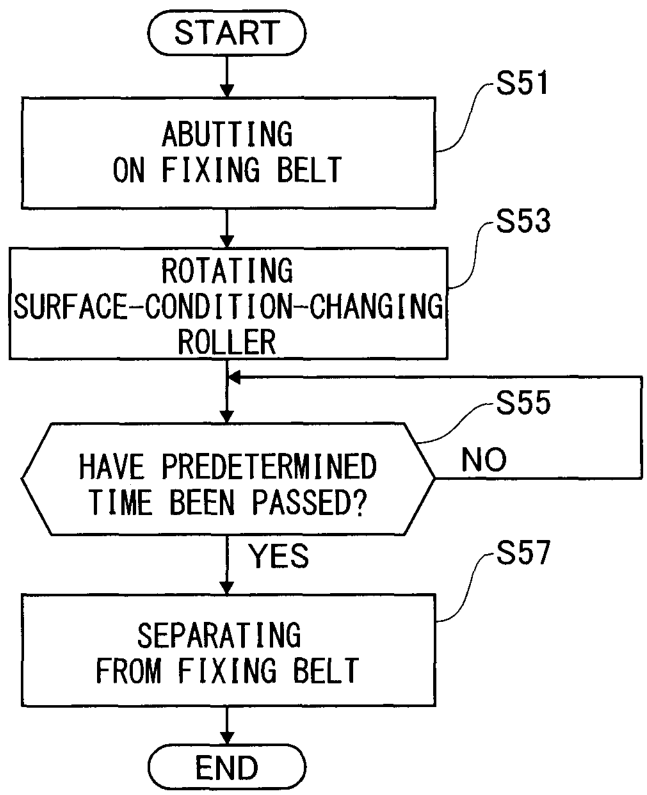

START
S51
ABUTTING ON FIXING BELT
S53
ROTATING SURFACE-CONDITION-CHANGING ROLLER
S55
HAVE PREDETERMINED TIME BEEN PASSED?
NO
YES
S57
SEPARATING FROM FIXING BELT
END

FIG.11

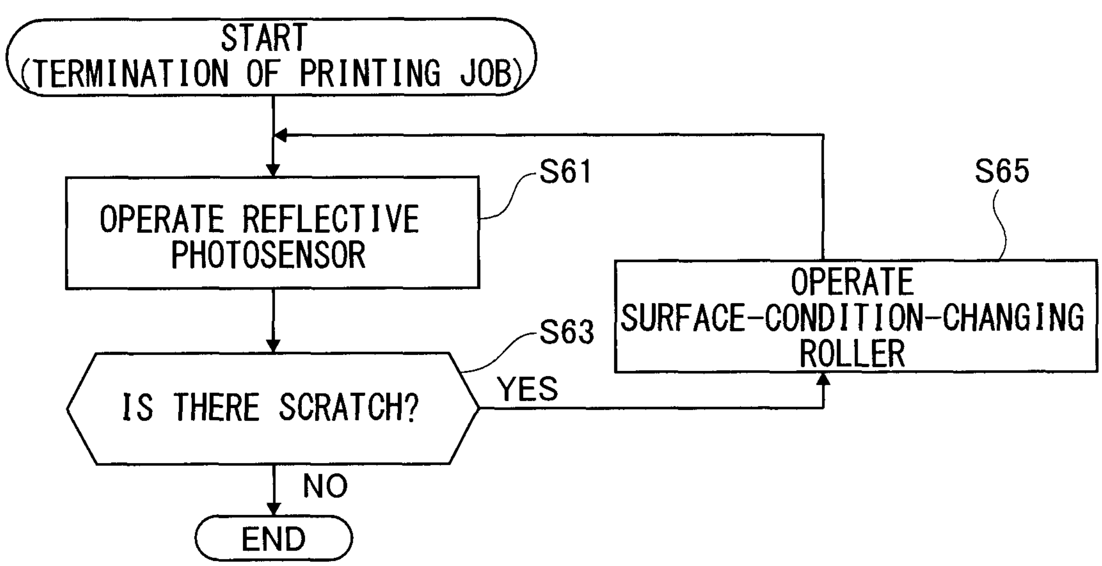

START (TERMINATION OF PRINTING JOB)
S61
OPERATE REFLECTIVE PHOTOSENSOR
S65
OPERATE SURFACE-CONDITION-CHANGING ROLLER
S63
IS THERE SCRATCH?
YES
NO
END

FIG.12

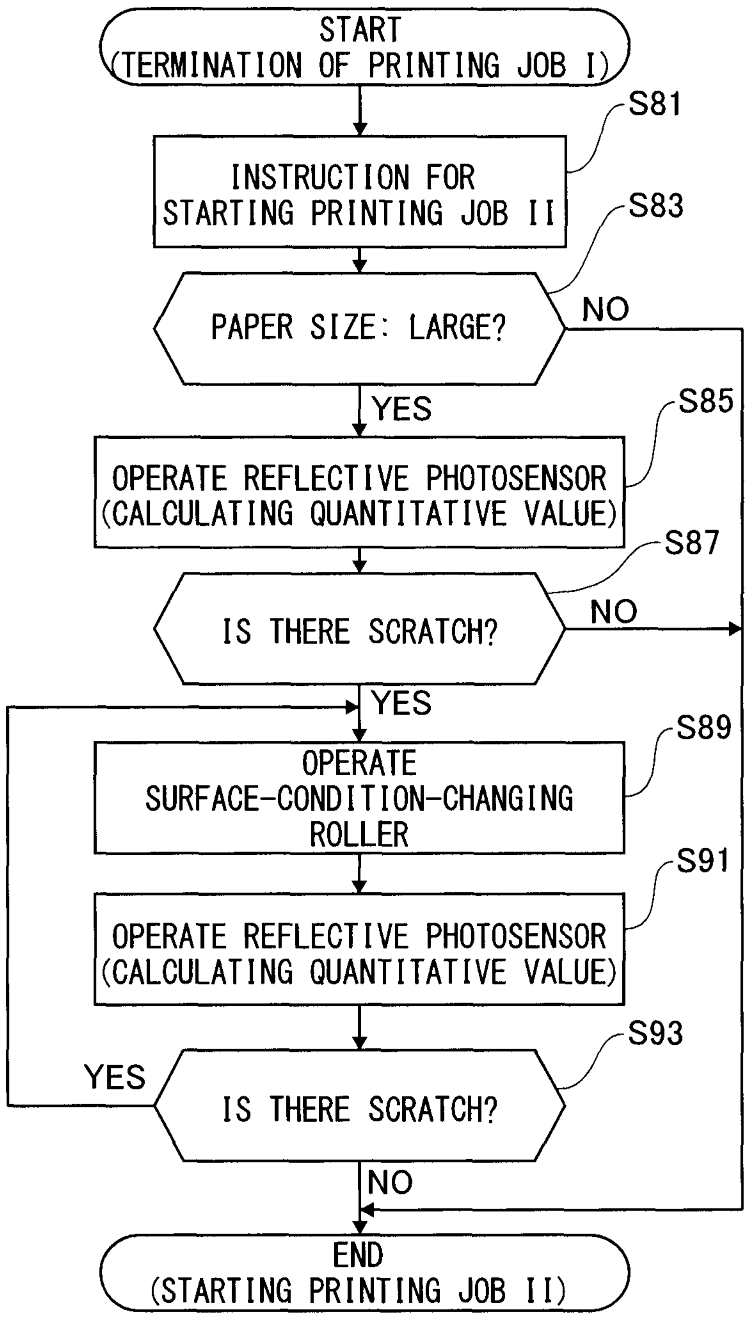

START
(TERMINATION OF PRINTING JOB I)
S81
INSTRUCTION FOR STARTING PRINTING JOB II
S83
PAPER SIZE: LARGE?
NO
YES
S85
OPERATE REFLECTIVE PHOTOSENSOR (CALCULATING QUANTITATIVE VALUE)
S87
IS THERE SCRATCH?
NO
YES
S89
OPERATE SURFACE-CONDITION-CHANGING ROLLER
S91
OPERATE REFLECTIVE PHOTOSENSOR (CALCULATING QUANTITATIVE VALUE)
S93
YES
IS THERE SCRATCH?
NO
END
(STARTING PRINTING JOB II)

FIG.13B

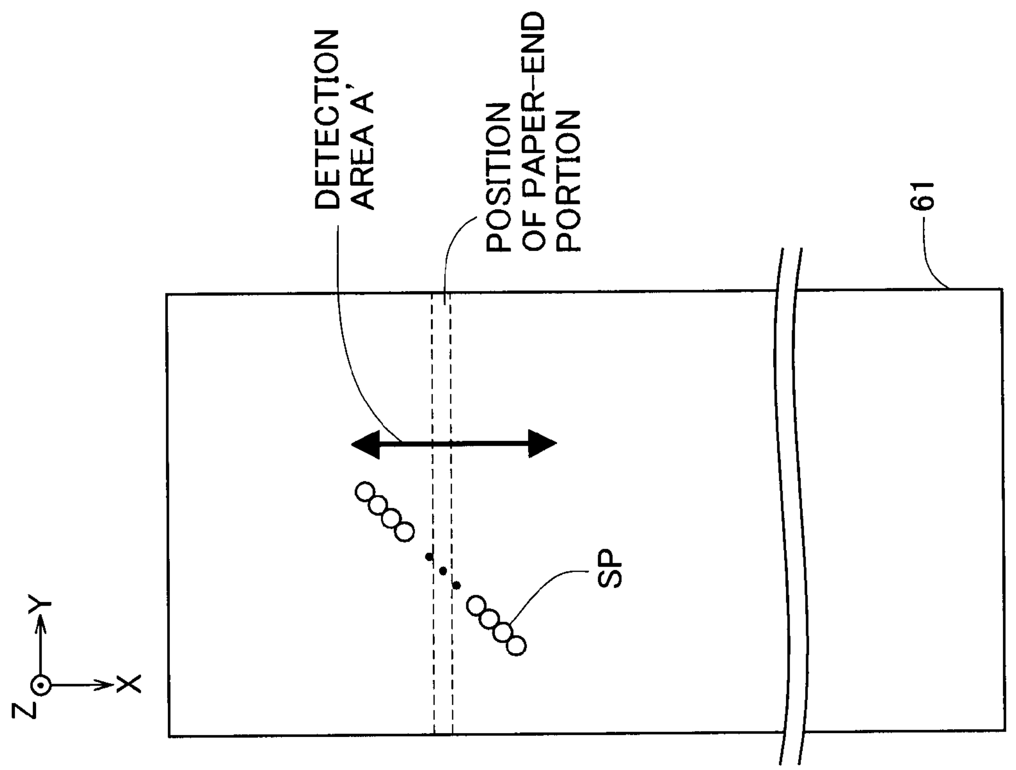


FIG.13A

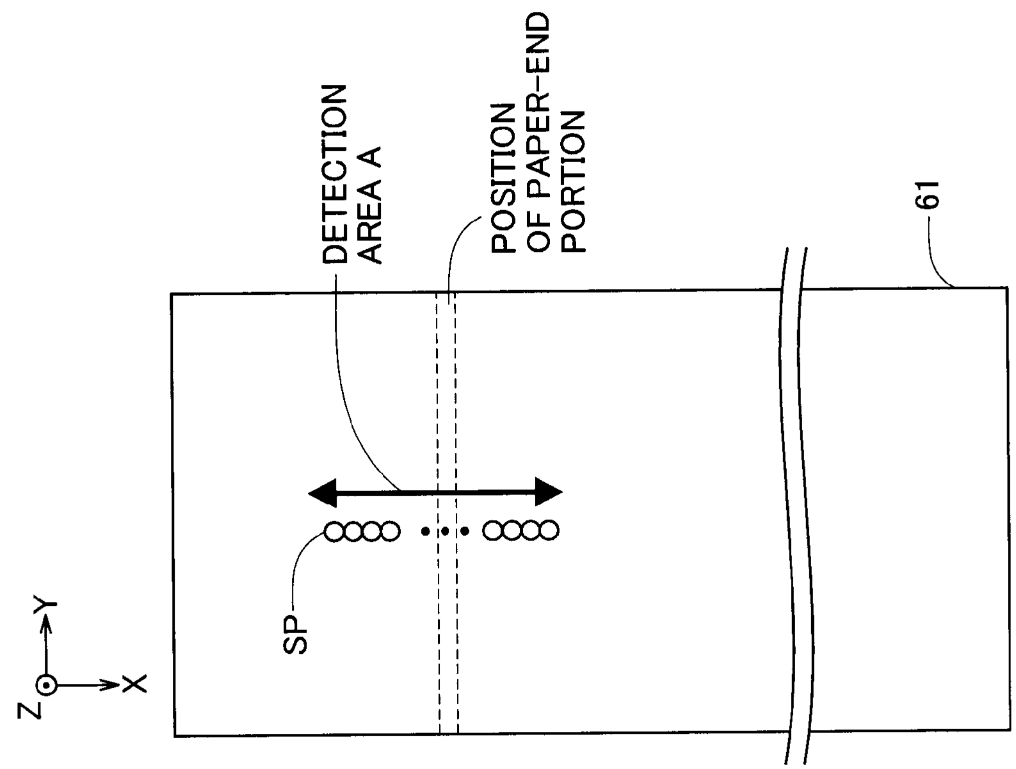
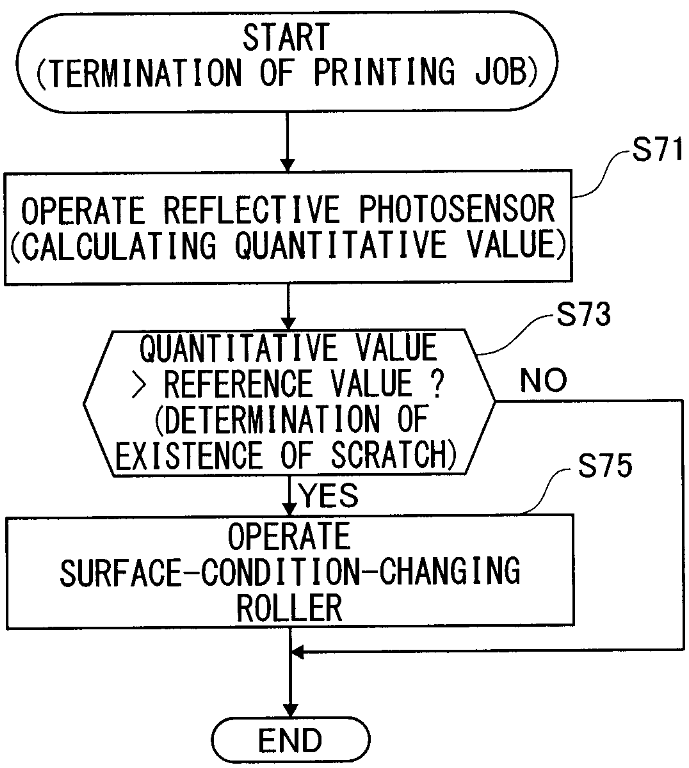


FIG.14


START
(TERMINATION OF PRINTING JOB)
S71
OPERATE REFLECTIVE PHOTOSENSOR
(CALCULATING QUANTITATIVE VALUE)
S73
QUANTITATIVE VALUE
> REFERENCE VALUE ?
(DETERMINATION OF
EXISTENCE OF SCRATCH)
NO
YES
S75
OPERATE
SURFACE-CONDITION-CHANGING
ROLLER
END

FIXING APPARATUS AND IMAGE-FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

The present application is based on and claims priority from Japanese Patent Application No. 2014-012898, filed on Jan. 28, 2014, and Japanese Patent Application No. 2014-053082, filed on Mar. 17, 2014, the disclosures of which are hereby incorporated by reference herein in their entirety.

BACKGROUND

1. Field of the Invention

The present invention relates to a fixing apparatus and an image-forming apparatus, in particular, a fixing apparatus for fixing a toner image onto a sheet-like recording medium, and an image-forming apparatus including the fixing apparatus.

2. Description of the Related Art

An image-forming apparatus which forms an image on a sheet-like recording medium is heretofore known. Such an image-forming apparatus includes an image bearer, an exposure device which forms a latent image by irradiating the image bearer with light modulated according to image information, a developing device which generates a toner image by attaching toner to the latent image, a transfer device which transfers the toner image onto a recording medium, and a fixing apparatus which includes a fixing belt for fixing the toner image onto a sheet-like recording medium.

In such a type of image-forming apparatus, it is known that a linear scratch is generated on a sliding portion with the end portion of the sheet-like recording medium (printing paper, for example) in the fixing belt, and a so-called streak in a gloss surface (glossiness unevenness) is generated on the image formed (printed, or the like) on the sheet-like recording medium due to the linear scratch generated on the fixing belt (for example, refer to Japanese Patent No. 4632820).

SUMMARY

Herein, because the level of the scratch (depth of the scratch, for example) generated on the fixing belt as described above does not always stay constant, the level of the streak (contrasting density of the streak, for example) generated on the sheet-like recording medium does not always stay constant. Therefore, it has been desired to reduce a variation in image quality (such as printing quality) due to a variation of such a streak.

The present invention aims to provide a fixing apparatus for fixing a toner image disposed on a sheet-like recording medium onto the sheet-like recording medium, comprising a fixing member relatively moving in a first direction with respect to the sheet-like recording medium, and having a surface in contact with the toner image during a fixing operation, a surface-information-detecting device for obtaining surface information of the fixing member, a surface-condition-changing device arranged to abut on and separate from the fixing member, and abrading the surface of the fixing member in contact with the fixing member, and a surface-condition-change controller for controlling an abutting and separating of the surface-condition-changing device with respect to the fixing member according to a detection result of the surface-information-detecting device, wherein the surface-condition-change controller controls the surface-condition-changing device according to the detection result of the surface-information-detecting device with a criteria which varies before and after the surface-condition-changing device abrades the fixing device.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are included to provide further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate Embodiments of the invention and, together with the specification, serve to explain the principle of the invention.

FIG. **1**A schematically illustrates a configuration of a color printer according to Embodiment of the present invention. FIG. **1**B schematically illustrates a configuration of an image-forming unit included in the color printer shown in FIG. **1**A. FIG. **1**C schematically illustrates a configuration of a fixing apparatus included in the color printer shown in FIG. **1**A.

FIG. **2** illustrates a relationship between the fixing apparatus and transfer paper.

FIG. **3**A illustrates a sectional view of a configuration of a reflective photosensor on an emission side. FIG. **3**B is an explanatory view illustrating an arrangement between a lens element, LED, and PD included in the reflective photosensor. FIG. **3**C is a plan view illustrating a substrate included in the reflective photosensor. FIG. **3**D is a sectional view illustrating a configuration of the reflective photosensor on a light-receiving side.

FIG. **4** illustrates an arrangement of a surface-condition-changing roller.

FIG. **5**A and FIG. **5**B illustrate each condition in which the surface-condition-changing roller abuts on the surface of the fixing belt, and in which the surface-condition-changing roller separates from the surface of the fixing belt.

FIG. **6** is a flow chart explaining the operation of the reflective photosensor.

FIGS. **7**A, **7**B and **7**C are graphs illustrating each output of a plurality of PD included in the reflective photosensor. FIG. **7**A is a graph corresponding to the fixing belt which has not been abraded by the surface-condition-changing roller. FIG. **7**B is a graph corresponding to the fixing belt immediately after being abraded by the surface-condition-changing roller. FIG. **7**C is a graph corresponding to the fixing belt after being abraded by the surface-condition-changing roller.

FIG. **8** is a graph illustrating a relationship between the output of the reflective photosensor and surface roughness of the fixing belt.

FIG. **9** is a flow chart illustrating a changing operation of the surface condition of the fixing belt.

FIG. **10** is a flow chart illustrating the operation of the surface-condition-changing roller.

FIG. **11** is a flow chart illustrating Modified Example 1 of the changing operation of the surface condition on the fixing belt.

FIG. **12** is a flow chart illustrating Modified Example 2 of the changing operation of the surface condition on the fixing belt.

FIG. **13**A illustrates an arrangement of a plurality of PD included in the reflective photosensor in Embodiment. FIG. **13**B illustrates Modified Example of an arrangement of the plurality of PD included in the reflective photosensor.

FIG. **14** is a flow chart illustrating the changing operation of the surface condition on the fixing belt according to the Modified Example.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, an Embodiment of the present invention will be described with reference to FIG. **1**A to FIG. **10**. A color printer **100** is schematically illustrated in FIG. **1**A as an example of an image-forming apparatus. The color printer **100** according to the present Embodiment is a so-called tandem-type printer. The color printer **100** includes a transfer belt **11**, optical scanning device **13**, cassette **15**, secondary transfer roller **17**, fixing apparatus **19**, image-forming unit UY, UM, UC, and UB. As described later, the optical scanning device **13** scans and exposes a photoconductor drum which is included in each of the image-forming units UY to UB with each scanning-light LY to LB. Hereinafter, in the description the main-scanning direction of the scanning-light LY to LB is referred to as an X-axis direction, a vertical direction of the scanning-light LY to LB is referred to as a Z-axis direction, and a direction which is perpendicular to the X-axis direction and the Z-axis direction is referred to as a Y-axis direction.

The transfer belt **11** as an intermediate transcriptional body is wound around a plurality of (three in the present Embodiment) rollers. The transfer belt **11** is driven by a driving roller which is one of the three rollers, for example, and rotates in a counterclockwise direction. Herein, the lower side portion of the transfer belt is tensed flat so as to be in parallel with a predetermined two-dimensional plane surface (horizontal plane, for example).

The image-forming units UY, UM, UC, and UB are arranged in an area through which the above-described planarly tensed portion of the transfer belt **11** passes. Herein, reference characters Y, M, C, and B in the figures each represent yellow, magenta, cyan, and black, respectively. The image-forming unit UY generates a yellow image, the image-forming unit UM generates a magenta image, the image-forming unit UC generates a cyan image, and the image-forming unit UB generates a black image.

The optical scanning device **13** is arranged on the lower side (−Z side) of the image-forming units UY to UB as an image-writing device. The cassette **15** is arranged below the optical scanning device **13**.

The above-described image-forming units UY to UB each have practically the same configurations; therefore, the image-forming unit UY will be described as a representative example with reference to FIG. **1**B.

As shown in FIG. **1**B, the image-forming unit UY includes a photoconductor drum **20**Y as a photoconductive photoconductor. A charger **30**Y as a contact-type charging roller, a developing unit **40**Y as an image-writing portion using the scanning-light LY, a transfer roller **50**Y, and a cleaning unit **60**Y are arranged around the photoconductor drum **20**Y. The transfer roller **50**Y is arranged on the opposite side of the photoconductor drum **20**Y through the transfer belt **11** so as to have contact with the rear surface of the transfer belt **11**. Herein, a rectangle shown in FIG. **1**B with a broken line represents the image-forming unit UY as a whole, although it does not always represent an actual configuration such as a casing.

The other image-forming units UM to UB shown in FIG. **1**A include the same configuration as the image-forming unit UY. Hereinafter, although not shown in the figures, each element included in the image-forming units UM to UB, such as photoconductor drums **20**M to **20**B, chargers **30**M to **30**B, developing units **40**M to **40**B, transfer rollers **50**M to **50**B, and cleaning units **60**M to **60**B will be described. In addition, scanning-light toward the image-forming units UM to UB is described as scanning-light LM to LB (refer to FIG. **1**A)

Next, a color image-printing process performed by the color printer **100** will be described simply.

Upon starting the color image generation process, the photoconductor drums **20**Y to **20**B and transfer belt **11** (refer to FIG. **1**B, for each) start rotating. Each rotational direction of the photoconductor drums **20**Y to **20**B is in a clockwise direction, and a rotational direction of the transfer belt **11** is in a counterclockwise direction (refer to an arrow shown in FIG. **1**B).

A photosensitive surface of each photoconductor drum **20**Y to **20**B is evenly charged by each of the chargers **30**Y to **30**B. The optical scanning device **13** (refer to FIG. **1**A) writes an image to each photoconductor drum **20**Y to **20**B by a light-scanning process using the scanning-light LY to LB. Herein, various types of optical scanning devices which perform such an image-writing process are heretofore well known. Such a well-known optical scanning device is used appropriately as the optical scanning device **13**.

The light-scanning process on the photoconductor drum **20**Y is performed by using a laser beam having a light intensity which is modulated according to the yellow image as the scanning-light LY. Thereby, the yellow image is written in the photoconductor drum **20**Y, and an electrostatic latent image corresponding to the yellow image is generated. The electrostatic latent image is a so-called negative latent image, and is visualized as a yellow toner image through reverse developing performed by the developing unit **40**Y using yellow toner. The visualized yellow toner image is electrostatically primarily transferred onto the reverse side of the transfer belt **11** by the transfer roller **50**Y.

The light-scanning process on the photoconductor drum **20**M is performed by using a laser beam having light intensity which is modulated according to the magenta image as the scanning-light LM. Thereby, the magenta image is written in the photoconductor drum **20**M, and an electrostatic latent image (negative latent image) corresponding to the magenta image is generated. The generated electrostatic latent image is visualized as a magenta toner image through reverse developing by the developing unit **40**M using magenta toner.

The light-scanning process on the photoconductor drum **20**C is performed by using a laser beam having light intensity which is modulated according to the cyan image as the scanning-light LC. Thereby, the cyan image is written in the photoconductor drum **20**C, and an electrostatic latent image (negative latent image) corresponding to the cyan image is generated. The generated electrostatic latent image is visualized as a cyan toner image through reverse developing by the developing unit **40**C using cyan toner.

The light-scanning process on the photoconductor drum **20**B is performed by using a laser beam having light intensity which is modulated according to the black image as the scanning-light LB. Thereby, the black image is written in the photoconductor drum **20**B, and an electrostatic latent image (negative latent image) corresponding to the black image is generated. The generated electrostatic latent image is visualized as a black toner image through reverse developing by the developing unit **40**B using black toner.

The magenta toner image is electrostatically primarily transferred onto the transfer belt **11** by the transfer roller **50**M. Herein, the magenta toner image overlaps with the yellow toner image which is transferred onto the transfer belt **11** ahead. Similarly, the cyan toner image is primarily transferred onto the transfer belt **11** by the transfer roller **50**C so as to overlap with the yellow toner image and the magenta toner image which are overlapped and transferred onto the transfer belt **11** ahead. The black toner image is primarily transferred onto the transfer belt **11** so as to overlap with each toner image of yellow, magenta, and cyan on the transfer belt **11** by the transfer roller **50**B.

Thereby, a color toner image is generated by overlapping each four-color toner image of yellow, magenta, cyan, and black on the transfer belt **11**. Each photoconductor drum **20**Y to **20**B is cleaned up by cleaning units **60**Y to **60**B after the toner image is transferred so that the remaining toner or paper dust in each photoconductor drum **20**Y to **20**B is removed.

Transfer paper S is stacked and stored in the cassette **15**. The transfer paper S is fed by a well-known sheet-feeding device (not shown), stops under the condition in which the tip portion of the transfer paper S is held by a timing roller (also referred to as a registration roller), and is sent into the secondary transfer part so as to match the timing of the transferring of the color toner image on the transfer belt **11**. Herein, the secondary transfer part represents an abutment part of the transfer belt **11** and the secondary transfer roller **17** which contacts with and rotates corresponding to the transfer belt **11**. The transfer paper S is sent into the secondary transfer part by the timing roller so as to match the timing of the arrival of the color toner image on the transfer belt **11** to the secondary transfer part.

Therefore, the color toner image is attached onto the transfer paper S, and electrostatically transferred (secondary transfer) onto the transfer paper S. The transfer paper S on which the color toner image is secondary transferred passes through the fixing apparatus **19**. Then, the fixing apparatus **19** fixes the color toner image on the transfer paper S. After that, the transfer paper S is discharged on a tray TR arranged on the upper portion of the color printer **100**.

The process of the color image printing which is performed by the color printer **100** is schematically described above. That is, the color printer **100** shown in FIG. **1**A generates one or more toner images (yellow to black toner image) by the electrophotography process, transfers these toner images onto the transfer paper S, and fixes the toner image (color toner image) which is borne in the transfer paper S on the transfer paper S by the fixing apparatus **19**.

Next, a configuration of the fixing apparatus **19** included in the color printer **100** shown in FIG. **1**A will be described with reference to FIG. **1**C. The fixing apparatus **19** is a so-called belt-fixing type fixing apparatus. The fixing portion of the fixing apparatus **19** includes a fixing belt **61** as a fixing member, as well as a heating roller **62**, pressure roller **63**, fixing roller **64**, tension roller **65**, peeling claw **66**, and surface-condition-changing roller **67**.

The fixing belt **61** includes a base material (basic layer) formed by nickel and polyimide or the like, and a mold-release layer formed by PFA (tetrafluoroethylene-perfluoroalkyl vinyl ether resin), PTFE (polytetrafluoroethylene) or the like. Furthermore, an elastic layer formed by silicon rubber or the like is included between the above base material and the mold-release layer. Accordingly, the surface of the fixing belt **61** is formed by resin which configures the mold-release layer, such as PFA and PTFE, and is set as an objective surface for detecting a scratch, as later described.

The fixing belt **61** is an endless belt, and is wound around a heating roller **62** and a fixing roller **64**, and a predetermined tension (required tension) is applied to the fixing belt **61** by a tension roller **65**. The heating roller **62** is for example, a hollow shaft roller formed by aluminum (or iron) or the like, and includes inside thereof a heat source H such as a halogen heater, or the like. The heating roller **62** heats the fixing belt **61** by the heat source H. Although not shown, a temperature sensor (thermopile or the like) for detecting the surface temperature of the fixing belt **61** is disposed on the surface of the fixing belt **61** so as not to have contact with the fixing belt **61**. A contact-type temperature sensor (thermistor) can be used in place of the contactless temperature sensor.

The fixing roller **64** is configured by a metal cored bar on which an elastic layer of silicon rubber or the like is overlaid. The fixing roller **64** drives the fixing belt **61** so as to rotate in a counterclockwise direction. The pressure roller **63** is configured by a cored bar of aluminum or iron or the like, on which an elastic layer of the silicon rubber or the like is overlaid. The pressure roller **63** includes a surface layer formed by a mold-release layer of PFA, PTFE, or the like. The pressure roller **63** presses against the fixing belt **61** on a position facing the fixing roller **64**. The fixing roller **64** is deformed by such pressure-contact, and thereby a nip portion is formed. The nip portion is arranged as the fixing portion for the color toner image which is electrostatically secondary-transferred onto the transfer paper S.

The tension roller **65** is configured by a metal cored bar on which an elastic layer of silicon rubber or the like is overlaid. A plurality of peeling claws **66** is arranged in an axis direction (direction vertical to the paper surface of the figures) of the fixing roller **64** so that a tip portion of the peeling claw abuts on the surface of the fixing belt **61**.

The surface-condition-changing roller **67** is configured by a metal cored bar on which a surface layer having a predetermined roughness is overlaid. The surface layer has, for example, a concave-convex configuration in the order of several tens of μm. When the surface-condition-changing roller **67** contacts with the surface of the fixing belt **61** and rotates, the surface of the fixing belt **61** is abraded by rubbing between the fixing belt **61** and the surface-condition-changing roller **67**. Thus a new surface is exposed. The surface-condition-changing roller **67** is accessible and separable to/from the fixing belt **61** as described later. Herein, a condition of the new surface is not always the same as the initial condition of the fixing belt **61** before being used (new product). The condition in which the linear scratch caused on the fixing belt **61** is undistinguished (for example, condition in which the linear scratch is inconspicuous among numbers of tiny scratches caused on the whole) is acceptable.

When the color toner image is fixed onto the transfer paper S in the fixing apparatus **19**, the pressure roller **63** rotates in the clockwise direction at the same time as the fixing belt **61** is heated by the heat source H and rotates in the counterclockwise direction. Then, when the surface temperature of the fixing belt **61** approaches the predetermined temperature which permits fixing, the transfer paper S on which the color toner image is transferred is fed in the arrow direction in FIG. **1**C and enters into the fixing part (nip portion). The color toner image receives heat from the fixing belt **61** on the transfer portion and also receives pressure by being pressed by the pressure roller **63** against the fixing belt **61**. Thereby, the color toner image is fixed onto the transfer paper S.

In addition, the color printer **100** includes a not-shown cleaning device which cleans up the transfer belt **11** (refer to FIG. **1**A). The cleaning device includes a cleaning brush which is arranged so as to face the portion in which the transfer belt **11** winds the roller in the left side of the image-forming unit UY in FIG. **1**A, and to contact with the transfer belt **11**, and a cleaning blade. The cleaning device cleans up the transfer belt **11** by scrubbing and removing foreign particles such as remaining toner and paper dust on the transfer belt **11**, or the like. The cleaning device also includes a discharge unit in order to discharge and discard the remaining toner which is removed from the transfer belt **11**.

Herein, a cutting section (edge portion) of the transfer paper S is sharp and sometimes a granular additive (such as calcium carbonate) may be exposed from the surface of the cutting section. Therefore, though the surface of the fixing belt **61** has no scratches at first in the fixing apparatus **19**, the linear scratch or the like is generated due to the sliding movement with the transfer paper S with the repetition of the fixing operation. Furthermore, so-called offset (adherence of toner to the fixing belt **61**) is generated on the surface of the fixing belt **61** with the repetition of the fixing operation in the fixing apparatus **19**. The above-described linear scratch is also generated due to the contact with the peeling claw **66** or the like. The linear scratch may be easily generated in the case in which the sheet-like recording medium is a plastic sheet used for an overhead projector. Hereinafter, the existence and non-existence and degree of the offset caused on the surface of the fixing belt **61** as well as the condition and position of the scratch are referred to as surface information of the fixing belt.

The fixing apparatus **19** includes a surface-information-detecting device for detecting the surface information of the fixing belt **61**. The surface-information-detecting device includes a reflective photosensor **200** which irradiates the surface of the fixing belt **61** with laser beam and receives reflective light of the laser beam, and a surface-information-detecting portion **300** which detects the surface information of the fixing belt **61** according to the detection result of the reflective photosensor **200**.

The reflective photosensor **200** is arranged to face a portion on the fixing belt **61** where the fixing belt **61** is wound around the heating roller **62**. The reflective photosensor **200** includes a light-emitting portion which emits a plurality of laser beam in a direction which is parallel to the width direction of the fixing belt **61** toward the surface of the fixing belt **61**, and a sensor portion which receives reflective light of the laser beam from the fixing belt **61** (the emitting portion and sensor portion are not shown in FIG. **1**C). The configuration and operation of the reflective photosensor **200** will be described in detail later. Because the width direction of the fixing belt **61** is in parallel with the main scanning direction in image-writing using the scanning light LY to LB (refer to FIG. **1**A), the width direction of the fixing belt **61** is referred to as the main-scanning direction.

The surface-information-detecting portion **300** is arranged inside the color printer **100** (refer to FIG. **1**A). The surface-information-detecting portion **300** is connected to the reflective photosensor **200** so as to detect the surface condition of the fixing belt **61** as the surface information upon receiving a sensing signal from the reflective photosensor **200**. In addition, the surface-information-detecting portion **300** also includes a function to control the performance of the reflective photosensor **200**.

FIG. **2** schematically illustrates the fixing apparatus **19**, which includes the reflective photosensor **200**. For example, A-4 size transfer paper can be fed to the fixing apparatus **19** in the longitudinal direction or in the short side direction of the paper by the color printer **100** (refer to FIG. **1**A) according to the present Embodiment. In FIG. **2**, the reference A**4**T represents the paper width when the A-4 size transfer paper S is fed in the longitudinal direction of the paper, and the reference A**4**L represents the paper width when the A-4 size transfer paper S is fed in the short side direction of the paper.

The dimension of the fixing belt **61** in the width direction (X axis direction) is set so as to be approximately the same as the paper width A**4**L. Accordingly, the linear scratch caused on an end portion of the fixing belt **61** in the longitudinal direction has no problem when the A-4 size transfer paper S is fed in the short side direction. In contrast, because the paper width A**4**T is shorter than the dimension of the fixing belt **61** in the width direction, the above-described problems of the linear scratch may occur when the A-4 size transfer paper S is fed in the longitudinal direction.

When a plurality of A-4 size transfer paper S is fed in the longitudinal direction of the paper, it cannot perfectly match each position of the transfer paper S in relation to the direction (up and down direction in the figures) which is in parallel to the width direction of the fixing belt **61**. That is, the positions of both end portions of the transfer paper S on the fixing belt **61** slightly move to the width direction of the fixing belt **61**. In addition, so-called belt deflection may occur in the fixing belt **61** itself and the positions of both end portions of each transfer paper S on the fixing belt **61** also slightly move. Furthermore, because the generation of the linear scratch is concentrated in a narrow area when the moving range of the position where the transfer paper S contacts with the fixing belt **61** is narrow, the position of the transfer paper S in relation to the fixing belt **61** may be purposely changed per each transfer paper S upon feeding a plurality of transfer paper S.

Thus, the fixing belt **61** and both end portions of the vertically-long transfer paper S in the paper width direction contact with each other within an area W**1** and W**2** (hereinafter, referred to as contact areas W**1** and W**2**) which have a predetermined width in relation to the direction in parallel with the width direction of the fixing belt **61**. The dimensions of the above contact areas W**1** and W**2** in the present Embodiment is, for example, about 10 mm.

Considering such contact areas W**1** and W**2**, when the A4-size transfer paper S is fed in the longitudinal direction of the paper, it is required to set the dimension of a detection area A to be larger than that of the contact areas W**1** and W**2** in the width direction when the surface condition (existence and non-existence of linear scratch, position, or the like) on the fixing belt **61** is detected.

Therefore, the detection area A for detecting the surface information of the fixing belt **61** by the reflective photosensor **200** in the fixing apparatus **19** is set to be larger than the contact area W**2** between the contact areas W**1** and W**2**. It is appropriate to set the detection area A to have a dimension of about 15 mm since the width dimension of the scratch is from about several hundreds of μm to about several mm and the movable range of the position of the scratch is about 10 mm in the present Embodiment. Herein, the detection area A (that is, reflective photosensor **200**) is not arranged in a position corresponding to the contact area W**1** in the present Embodiment. This is because the linear scratch on the fixing belt **61** may be generated approximately the same on both contact area W**1** and contact area W**2**, and it is practically sufficient as long as the surface information of the fixing belt **61** is obtained on at least one of the contact area. Of course, the detection area A can be set corresponding to both contact area W**1** and contact area W**2**. Furthermore, the dimension of the detection area A can be set so as to cover the width of the fixing belt **61** entirely.

The reflective photosensor **200** emits a plurality of detection light at a predetermined interval toward a direction which is in parallel with the width direction (X-axis direction) of the fixing belt **61**. The area being irradiated by the detection light configures the detection area A. The relative positional relationship between the reflective photosensor **200** and the end portion of transfer paper S in the paper width direction can be made in a comparatively rough arrangement because the reflective photosensor **200** can form the long detection area A.

The surface-information-detecting portion **300** quantifies (process of quantification will be described later) the position of the linear scratch generated by the end portion of the transfer paper S in the width direction and the level of scratch as the surface information of the fixing belt **61** according to the detection signal from the reflective photosensor **200**. The level of the scratch herein represents an extent of the scratch, that is, a depth of the scratch (difference in the surface roughness between the scratch portion and the portion without scratches).

Next, an example of a configuration of the reflective photosensor (reflective-type optical detecting device) **200** will be described with reference to FIG. **3**A to FIG. **3**D.

As shown in FIG. **3**A to FIG. **3**D, the reflective photosensor **200** includes a substrate **201**, lateral plates **202** and **203**, lateral plates **205** and **206** (not shown in FIG. **3**A, refer to FIG. **3**B, for each), and a lens element **204**.

As shown in FIG. **3**C, a plurality of LEDs (Light Emitting Diode) **211**, and a plurality of photo diode **212** (hereinafter, referred to as PD **212**) are arranged on the substrate **201** to have a predetermined interval in the X-axis direction. The number of LED **211** to be arranged is determined according to a design condition. Generally, several tens to several hundreds of the LEDs **211** can be arranged. The number of PD **212** is similar to the number of LED **211**, and the arrangement pitch of the PD **212** is similar to that of the LED **211**.

To make the description simple, each LED **211** is assigned a number individually from left side of FIG. **3**C in order. The n^{th} one from the left side is represented as LED $\mathbf{211}_n$. When the total number of LED **211** is supposed to be N, the total LEDs **211** are therefore arranged as LED $\mathbf{211}_1$, $\mathbf{211}_2$ . . . , $\mathbf{211}_n$ . . . , $\mathbf{211}_N$, in order. Similarly, the PD **212** is assigned a number from left side of FIG. **3**C one by one in order, and n^{th} one from the left side is represented as PD $\mathbf{212}_n$. The total number of PD **212** is N and the arrangement of the total PD **212** is therefore represented as PD $\mathbf{212}_1$, $\mathbf{212}_2$ . . . , $\mathbf{212}_n$ . . . $\mathbf{212}_N$, in order.

LED $\mathbf{211}_n$ (n=1 to N) and PD $\mathbf{212}_n$ (n=1 to N) correspond to one for one. As shown in FIG. **3**C, LED $\mathbf{211}_n$ and PD $\mathbf{212}_n$ which correspond to each other are arranged so as to be in the parallel position in the X-axis direction.

The lens element **204** is configured by two areas which include an area for an irradiation lens array in which each irradiation lens $\mathbf{204}_n$ (n=1 to N) is arranged in an array as shown in FIG. **3**A, and an area for a light-receiving lens **204**C as shown in FIG. **3**D.

The number of the irradiation lens $\mathbf{204}_n$ is the same as that of the LED **211** (N). Each irradiation lens $\mathbf{204}_n$ is arranged on the direction Y side of the LED **211** so that the LED $\mathbf{211}_n$ corresponds to the irradiation lens $\mathbf{204}_n$ one by one for each. The irradiation lenses $\mathbf{204}_n$ are arranged in the X-axis direction at the predetermined intervals. The light-receiving lens **204**C is a single cylindrical lens including a positive power only in the Z-axis direction as shown in FIG. **3**D, and is arranged on the direction Y side of the PD $\mathbf{212}_1$ to $\mathbf{212}_N$. The irradiation lens array portion in which the irradiation lens $\mathbf{204}_n$ (n=1 to N) is formed and the portion in which the light-receiving lens **204**C is formed can be combined by, for example, resin molding using a synthetic resin material.

The reflective photosensor **200** includes a light-shielding wall $\mathbf{231}_n$ (n=1 to N−1) in order to prevent flare light between the groups adjacent to each other in the group of the LED $\mathbf{211}_n$ and irradiation lens $\mathbf{204}_n$ as shown in FIG. **3**A and FIG. **3**D. In addition, the reflective photosensor **200** includes a light-shielding wall **232** in order to prevent flare light between the LED $\mathbf{211}_n$ array and the PD $\mathbf{212}_n$ array as shown in FIG. **3**B.

In addition, the lateral plates **202** and **203** (refer to FIG. **3**A) and lateral plates **205** and **206** (refer to FIG. **3**B) are combined so as to configure a case for reflective photosensor **200**. The case (lateral plates **202**, **203**, **205**, and **206**), light-shielding wall $\mathbf{231}_n$ (refer to FIG. **3**A), light-shielding wall **232** (refer to FIG. **3**B), and lens element **204** can be combined by resin molding using synthetic resin material, for example.

As shown in FIG. **3**A, when the LED $\mathbf{211}_n$ is turned on, a bundle of irradiated divergent light is concentrated by the irradiation lens $\mathbf{204}_n$ which corresponds to the LED $\mathbf{211}_n$ and irradiates the surface of the fixing belt **61** in the reflective photosensor **200**. As shown in FIG. **3**B, reflective light from the portion irradiated by the bundle of light from the LED $\mathbf{211}_n$ (referred to as light spot) on the surface of fixing belt **61** is concentrated by the light receiving lens **204**C only in the Z-axis direction, and enters into the PD $\mathbf{212}_n$.

The fixing apparatus **19** includes a surface-condition-change controller **400** so as to control the performance of the surface-condition-changing roller **67** as shown in FIG. **1**C. The surface-condition-change controller **400** is arranged inside the color printer **100** (refer to FIG. **1**A). The surface-condition-change controller **400** is connected to the surface-condition-changing roller **67** so as to control the performance of the surface-condition-changing roller **67** according to the detection result from the surface-information-detecting portion **300** (detection signal from the reflective photosensor **200**). Such a control process will be described later.

The surface-condition-changing roller **67** performs the abutting, separating and sliding operation with regard to the fixing belt **61** by a driver which is not shown in FIG. **1**C. The not-shown driver and the surface-condition-changing roller **67** configure the surface-condition-changing device. The driving means is controlled by the surface-condition-change controller **400**.

As shown in FIG. **4**, the surface-condition-changing roller **67** is disposed on a rotational axis **68**. The length of the surface-condition-changing roller **67** in the parallel direction to the rotational axis **68** (direction conforming to the width direction of fixing belt **61**) is set so as to change the surface condition of approximately the whole area of the fixing belt **61** in the width direction. Thereby, not only that the surface of the fixing belt **61** can be refined by abrading the linear scratch generated on the fixing belt **61** due to the sliding friction between the both end portions of the transfer paper S (not shown in FIG. **4**, refer to FIG. **2**) in the paper width direction, but the surface of the fixing belt **61** can be uniformly reformed over the approximately total area of the fixing belt **61** in the width direction. The surface condition can be similarly refined effectively from the scratch generated by a stripping claw or the temperature sensor, or from the offset.

It is appropriate that the surface-condition-changing roller **67** be arranged so as to achieve at least an object such that the surface condition of the portion on which the linear scratch is generated in the fixing belt **61** can be changed. For example, a pair of surface-condition-changing rollers (not shown) which has a narrower width (short length in the direction of rotational axis **68**) than that of the surface-condition-changing roller **67** shown in FIG. **4** can be provided on a position corresponding to the contact areas **W1** and **W2**. In this case, it is appropriate that each width diameter of the not-shown rollers be slightly shorter than the detection area A and slightly longer than the contact areas **W1** and **W2**.

As schematically shown in FIG. **5**A to FIG. **5**B, the surface-condition-changing roller **67** is supported by a rod **69**. The rod **69** is connected to the rotational axis **68** and these rod **69** and rotational axis **68** are controlled by the surface-condition-change controller **400**. FIG. **5**A illustrates the state of the surface-condition-changing roller **67** in contact with the surface of the fixing belt **61**. FIG. **5**B illustrates the state of the surface-condition-changing roller **67** being separated from the fixing belt **61**. Thus, the surface-condition-changing roller **67** is connectable and separable to/from the fixing belt **61**.

A control portion of the reflective photosensor **200** and surface-condition-changing roller **67** in the surface-information-detecting portion **300** and surface-condition-change controller **400** may be configured as a microcomputer or CPU. The control portion can be stored in one computer as a control program.

Next, a detecting operation of the surface condition of the fixing belt **61** by the surface-information-detecting portion **300** using the reflective photosensor **200** will be described with reference to the flow chart shown in FIG. **6**.

In the present Embodiment, the surface-information-detecting portion **300** repeats the switching on and off operation on the LED $\mathbf{211}_1$ to LED $\mathbf{211}_N$ in FIG. **3**A one by one in order, that is, the surface-information-detecting portion **300** operates so-called sequentially lightning. Therefore, the surface-information-detecting portion **300** inputs n=1 in step S**01**, and turns on the LED $\mathbf{211}_n$ (LED $\mathbf{211}_1$) in the following step S**03**, then the process proceeds to step S**05**.

The surface-information-detecting portion **300** selects the PD **212** which receives the reflective light from the fixing belt **61** upon synchronizing with the lighting of the n^{th} LED $\mathbf{211}_n$ in step S**05**. Herein, because the reflective light from the fixing belt **61** is not a specular reflection and it spreads toward the X-axis direction, and also, the reflective light upon turning on the LED $\mathbf{211}_n$ is received by the corresponding PD $\mathbf{212}_n$ and the other PD **212** which is adjacent to the PD $\mathbf{212}_n$. To make the description simple, the number of the PD **212** for receiving light is an uneven number and it is supposed to be (2m+1) when m is an integral number in the present Embodiment. That is, the reflective light upon turning on the LED $\mathbf{211}_n$ is received by the corresponding PD $\mathbf{212}_n$ and the 2m+1 PDs which are arranged on both sides of the PD $\mathbf{212}_n$. For example, supposing m=2, the PD which receives the reflective light is five including PD $\mathbf{212}_{n-2}$, PD $\mathbf{212}_{n-1}$, PD $\mathbf{212}_n$ (corresponds to LED $\mathbf{211}_n$), PD $\mathbf{212}_{n+1}$, and PD $\mathbf{212}_{n+2}$. However, the number of the PD for receiving light is not five but three of PD $\mathbf{212}_1$, PD $\mathbf{212}_2$, and PD $\mathbf{212}_3$ when n=1 and the LED $\mathbf{211}_1$ is turned on, even if m=2 herein. Similarly, the number of PD for receiving light is not five but three of PD $\mathbf{212}_{N-2}$, PD $\mathbf{212}_{N-1}$, and PD $\mathbf{212}_N$ provided that n=N.

After the predetermined time which is sufficient for receiving reflective light from the fixing belt **61** has passed, the surface-information-detecting portion **300** turns off the LED $\mathbf{211}_n$ (LED $\mathbf{211}_1$, herein) in the following step S**07**. When turning on/off operation of the LED **211** is performed, a plurality of PD **212** which receives the reflective light performs photoelectric conversion of the amount of received light. The photoelectrically converted signal becomes a detection signal after being amplified. Each detection signal of PD **212** is sent to the surface-information-detecting portion **300** in each detection operation. The surface-information-detecting portion **300** receives the signal in step S**09** and the process goes to step S**11**.

In step S**11**, the surface-information-detecting portion **300** detects whether the sequential lighting of a plurality of LEDs **211** is finished or not. That is, the surface-information-detecting portion **300** determines that it does not receive the detection signals from all of the PD $\mathbf{212}_1$ to PD $\mathbf{212}_n$ when n<N, and increments n in the following step S**13**, then the process returns to step S**03**. Thereafter, when n=N after the repetition of the sequential lightning by all LEDs and the LED $\mathbf{211}_N$ is turned on and off, the sequential lighting is finished because such a process is determined as one cycle. When n becomes equal to N (n=N) in step S**11**, the process operated by the surface-information-detecting portion **300** goes to step S**15**.

Herein, in the present Embodiment, in order to increase the accuracy of detection by each PD $\mathbf{212}_1$ to **212**N, several cycles of the above-described sequential lightning of LED **211** (step S**1** to step S **13**) are performed and for example, a process to average the detection result in each cycle can be performed as well. In step S**15**, the surface-information-detecting portion **300** determines whether it should repeat the sequential lightning of LED $\mathbf{211}_1$ to $\mathbf{211}_N$ or not. When the surface-information-detecting portion **300** determines to perform the sequential lighting, the process returns to step S**01** and the surface-information-detecting portion **300** repeats the succeeding process. When the surface-information-detecting portion **300** determines not to repeat the sequential lighting, the process is terminated. Herein, it is not necessary to turn on or off all N of LEDs **211**, but the arbitral N' (≤N) therein can be used for lightning on/off. For example, For example, it is not necessarily to use N of LEDs $\mathbf{211}_1$ to $\mathbf{211}_N$ for the sequential lightning on/off, but it can be configured to light on and off the LED $\mathbf{211}_3$ to LED $\mathbf{211}_{N-2}$, thus the N−4 LEDs excepting each two LED on both ends.

In addition, when the detection signal from the PD **212** is sent to the surface-information-detecting portion **300**, the surface-information-detecting portion **300** obtains the surface information of the fixing belt **61** in accordance with the following process.

When the surface-information-detecting portion **300** receives the detection signal (the number of detection signal is 2m+1 with respect to the turning on/off operation of a single LED, in principle) from each PD ($\mathbf{212}_1$ to $\mathbf{212}_N$), the surface-information-detecting portion **300** calculates the sum of the total detection signals (2m+1) at each time it receives the detection signal, and determines the calculation result herein as the detection result R_n (n=1 to N). Thereby, the surface-information-detecting portion **300** can obtain the detection result R_n regarding a plurality of points (light spot) on the fixing belt **61** which corresponds to a plurality of LEDs **211** arranged on the fixing belt **61** in the width direction of the fixing belt **61** so as to have predetermined intervals. Herein, the detection result R_n is not the value detected by PD but the corrected value after the variation of light amount between a plurality of light spots, individual variability of the sensor, the light amount change according to the temperature change are corrected. The surface-information-detecting portion **300** sequentially determines the surface information of the fixing belt **61** according to the above detection result R_n. Hereinafter, the detection result R_n is also referred to as reflection intensity R_n.

FIG. **7**A to FIG. **7**C illustrate a graph in which a variation in reflection intensity R_n (arbitral light intensity R_n) generated according to an output from the reflective photosensor **200** is shown as an example. Herein, the graphs shown in FIG. **7**A to FIG. **7**C are generated under the condition in which each arrangement number of the LED **211** and PD **212** in the reflective photosensor **200** is N=24, and the LED to be turned on sequentially is n=4 to 21 as an example.

Herein, generally, a regularly reflected component in the reflective light from the fixing belt **61** decreases and a dispersing reflective component increases when the fixing belt **61** has a scratch on the surface thereon, compared with the case in which the fixing belt **61** does not includes the scratch. According to the above-described example, the regularly reflected component decreases on a spot on the reflection position (light spot) having a scratch so the received amount of light by the PD $\mathbf{212}_n$ decreases compared with the case without the scratch, but the received amount of light increases on the surrounding PD $\mathbf{212}_{n-m}$ to PD $\mathbf{212}_{n-1}$, PD $\mathbf{212}_{n+1}$ to PD $\mathbf{212}_{n+m}$. However, in a comprehensive manner, the value of the detection result R_n according to the portion including the scratch decreases compared with that in the portion having the scratch. In accordance with such a characteristic feature of the detection signal, the surface-information-detecting portion **300** quantifies the existence and non-existence of the scratch, the level of the scratch, and the position of the scratch as the surface information. By turning on a plurality of LEDs and using the received light amount in the PD relatively with the detection, it is capable of distinguishing the decrease in the light amount received by the PD due to the decrease in the light amount of LED caused by the time degradation, the decrease in the light amount received by the PD because the fixing belt is deteriorated thoroughly (for example, there are tiny scratches on the entire fixing belt) although the linear scratch is not generated, and the decrease of the light amount received by the PD caused by the generation of the scratch.

Next, an example of a method to qualify the surface information by the surface-information-detecting portion **300** according to the detection result R_n shown in FIG. **7**A will be described. The surface-information-detecting portion **300** determines a range where the minimum value R_{min} of the detection result R_n is extracted as shown in FIG. **7**A. The range where the minimum value (R_{min}) of the detection result R_n is extracted is defined because the reflective light from the LED **211** arranged around both end side portions of the fixing belt **61** in the width direction (X-axis direction) deviates from the corresponding PD **212** when an installation error of the reflective photosensor **200** (refer to FIG. **3**A) is in the direction θz (rotational direction around the rotational axis Z), thus the accuracy in the detection result R_n may deteriorate. Therefore, a selection range is determined so that the accuracy of the detection result R_n does not fall even though the reflective photosensor **200** includes a possible installation error in the direction θz. In the present Embodiment, the output of the PD $\mathbf{212}_4$ to PD $\mathbf{212}_6$ and PD $\mathbf{212}_{19}$ to PD $\mathbf{212}_{21}$ is not used in extraction of the minimum value R_{min} as an example.

Next, the surface-information-detecting portion **300** determines the minimum value R_{min} in the above-described selection range. It can be understood that the minimum value R_{min} is the detection result R_{12} of the PD $\mathbf{212}_{12}$ from the graph shown in FIG. **7**A. That is, it is determined that the fixing belt **61** includes a linear scratch on the portion (light spot) which is irradiated by the bundle of light emitted from LED $\mathbf{211}_{12}$.

Next, the surface-information-detecting portion **300** quantifies the level of the scratch using the graph shown in FIG. **7**A. Specifically, the surface-information-detecting portion **300** extracts the maximum value R_{max} of the detection result R_n at each area closer to one side portion and the other side portion of the fixing belt **61** in the width direction which have no scratch relative to the light spot where the minimum value R_{min} (herein, detection result R_{12}) is obtained. That is, the surface-information-detecting portion **300** extracts the maximum value R_{max} of the detection result R_n on each area on the fixing apparatus **61** without any linear scratch, and calculates the average value R_{ave} of each maximum value R_{max} on the one side portion or the other side portion of the fixing belt **61**. It can be understood that the maximum value R_{max} is the detection result R_4 and R_{20} of the PD $\mathbf{212}_4$ and PD $\mathbf{212}_{20}$ in the example shown in FIG. **7**A. Then, the value ($R_{ave}-R_{min}$) which is the average value R_{ave} minus the minimum value R_{min} is obtained as the quantitative value of the linear scratch on the fixing belt **61**. The surface-information-detecting portion **300** determines the existence and non-existence of the scratch by determining whether or not the above quantitative value exceeds a predetermined reference value. Herein, even though a linearly scratch is actually generated on the fixing belt **61**, it will be determined as "non-existence of scratch" when the extent of the scratch can be determined such that it causes no problem with the level of the streak which comes up on the printed image due to such a linear scratch. "Existence of scratch" is determined only in the case in which the extent of the streak on the gloss surface generated due to the linear scratch has a problem.

Herein, in the present Embodiment, the predetermined reference value which is used upon determining the existence and non-existence of the scratch on the fixing belt **61** by the surface-information-detecting portion **300** varies according to the fact that the surface of the fixing belt **61** has been abraded by the surface-condition-changing roller **67** once before (in other words, it defers before or after abrasion on the fixing belt **61** by the surface-condition-changing roller **67**). The reason of the above will be described hereinafter.

The above-described FIG. **7**A indicates the output of the reflective photosensor **200** after performing the printing operation using the fixing belt **61** having the surface which has never been abraded by the surface-condition-changing roller **67** before. On the other hand, FIG. **7**B illustrates an example of a graph showing the variation of reflective light intensity R_n (arbitral light intensity R_n) when the fixing belt **61** is calculated using the reflective photosensor **200** after the surface of the fixing belt is abraded by the surface-condition-changing roller **67**. It is clear that the quantitative value (difference between the average value R_{ave} of the maximum value R_{max} and the minimum value R_{min}) in the example as shown in FIG. **7***b* is smaller than that in the example shown in FIG. **7**A. In addition, FIG. **7**C illustrates an example of a variation graph of the reflective light intensity R_n (arbitral light intensity R_n) when the reflective photosensor **200** calculates the fixing belt **61** which is used in the printing operation after the surface thereof is abraded by the surface-condition-changing roller **67**. Similar to the example shown in FIG. **7**A, the quantitative value (difference between average value R_{ave} of the maximum value R_{max} and the minimum value R_{min}) in the example shown in FIG. **7**C is larger than that in the example shown in FIG. **7**B, and it is clear that the linear scratch is generated on the portion (light spot) on the fixing belt **61** irradiated by a bundle of light from the LED $\mathbf{211}_{12}$.

FIG. **8** is a graph illustrating a relationship between the detected value R_n (arbitral light intensity R_n) obtained by the surface information detector (reflective photosensor **200**) and a measured result of the surface roughness of the fixing belt **61** using a surface roughness meter. The surface roughness herein represents the average value of the surface roughness of the predetermined area on the fixing belt **61**. It is clear from FIG. **8** that there is a correlative relationship between the surface roughness of the fixing belt **61** and the sensor detection value R_n, and such a correlation fits well with an exponent function (in the present Embodiment, supposing Y as the detected value R_n, and X as the surface roughness, $Y=8.08X^{-1.83}$). Thereby, the approximate surface roughness of the fixing belt **61** can be calculated from the detected value R_n obtained by the reflective photosensor **200**.

Even if the quantitative value obtained in relation to the fixing belt **61** which has never been abraded by the surface-condition-changing roller **67** and the quantitative value obtained in relation to the fixing belt **61** which has been abraded by the surface-condition-changing roller **67** are identical, it is clear from the graph shown in FIG. **8** (FIG. **8** shows that the detected value R_n and the surface roughness are not in the proportional relationship) that there is a difference in surface roughness between the portion having the scratch (portion where the linear scratch is generated thereon) and the portion without the scratch (portion where the liner scratch is not generated thereon), which the detected value Rn and the surface roughness is not in the proportional relationship, because the detected value R_n itself of the reflective photosensor **200** varies for each (generally, the value in the former case is bigger than that in the latter case as shown in FIG. **7**A and FIG. **7**C). Therefore, the level of the streak on the image generated due to the linear scratch varies accordingly.

In addition, when the difference in surface roughness between the scratch portion and the portion without scratch is calculated from the above-described quantitative value using the graph (including the relational expression) in FIG. **8**, and when the existence and non-existence of the scratch is determined according to whether the calculated value exceeds the predetermined reference value, the level of the streak on the image generated due to the linear scratch differs even if the surface roughness on the scratch portion is similar to the portion without the scratch. The surface roughness between the scratch portion and the portion without the scratch significantly vary according to the fact that the scratch is generated on the fixing belt **61** which has never been abraded by the surface-condition-changing roller **67** or generated on the fixing belt which has been abraded by the surface-condition-changing roller **67**.

Therefore, the level of the streak generated on the printed image cannot be constantly maintained if the existence and non-existence of the scratch is determined by comparing using the same reference value the quantitative value obtained by the reflective photosensor **200** in relation to the scratch on the fixing belt **61** which has never been abraded by the surface-condition-changing roller **67** and the quantitative value obtained by the reflective photosensor **200** in relation to the scratch on the fixing belt **61** which has been abraded by the surface-condition-changing roller **67**. Accordingly, the reference value which is used in determining the existence and non-existence of the scratch on the fixing belt **61** is changed according to whether the fixing belt has been abraded by the surface-condition-changing roller **67** once before or not (that is, in the case of FIG. **7**A and in the case of FIG. **7**C) in the present Embodiment.

The changing operation on the surface of the fixing belt **61** is performed according to the procedure illustrated in the flow chart shown in FIG. **9**.

As shown in FIG. **9**, when a printing job (a unit of a job to be executed by a computer) is terminated (image-forming process is terminated), the surface-information-detecting portion **300** gets the reflective photosensor **200** to work according to the flow chart shown in FIG. **6** under the condition that the fixing belt **61** is rotated, and calculates the above-described quantitative value in step S**41**. When the performance of the reflective photosensor **200** is terminated, the surface-information-detecting portion **300** determines whether the fixing belt **61** has been abraded before or not in the following step S**43**. The detailed method for such a determination is performed by turning on a flag upon changing the belt to a new one, and turning off the flag upon abrading the surface thereof once. Otherwise, the detected value R_n of the surface-information-detecting portion **300** in relation to the portion without the scratch is used for the determination. In detail, the detection is performed according to whether the average value R_{ave} of the maximum value R_{max} shown in FIG. **7**A to FIG. **7**C exceeds a predetermined threshold or not.

When the detection result is NO in step S**43**, the process proceeds to step S**45***a*, and when the detection result is YES in step S**43**, the process proceeds to step S**45***b*. In step S**45***a* and step S**45***b*, the surface-information-detecting portion **300** determines whether the quantitative value obtained in step S**41** exceeds the predetermined reference value or not. In this regard, a reference value A is used in the determination in step S**45***a* and a reference value B which is different from the reference value A is used in the determination in step S**45***b*.

When the quantitative values used in step S**45***a* and S**45***b* do not exceed (NO determination) the reference value (reference value A or reference value B in steps S**45***a* and S**45***b*), it is determined that a scratch which may cause a problem in relation to the printing quality is not generated on the fixing belt **61**, and the surface-information-detecting portion **300** terminates the process. On the other hand, when the quantitative values exceed the reference value (reference value A or reference value B) in step S**45***a* and step S**45***b*, each process goes to step S**47***a* and step S**47***b*.

In step S**47***a* and step S**47***b*, the surface-information-detecting portion **300** determines the operation time of the surface-condition-changing roller **67** according to the quantitative value calculated in step S**41**, that is, the abutting time of the surface-condition-changing roller **67** with the fixing belt **61**. The abutting time to be determined herein is required for maintaining the level of the streak generated on the printed image due to the linear scratch on the fixing belt **61** to be at a certain level or less. The relationship between the quantitative value and the abutting time varies according to whether the surface of the fixing belt **61** has been abraded at least once by the surface-condition-changing roller **67** or not. A relationship table (function or compendium) between the quantitative value regarding the fixing belt **61** which has been abraded by the surface-condition-changing roller **67** at least once and the abutting time, and a relationship table (function or compendium) between the quantitative value regarding the fixing belt **61** which has never been abraded by the surface-condition-changing roller **67** and the abutting time are preset in the present Embodiment. One of the above two tables is selected according to whether the surface of the fixing belt **61** has been abraded by the surface-condition-changing roller **67** before.

After the abutting time of the surface-condition-changing roller **67** with the fixing belt **61** is determined in step S**47***a* and step S**47***b*, the surface-condition-change controller **400** controls the performance of the surface-condition-changing roller **67** as follows through the detection result from the surface-information-detecting portion **300** in the following step S**49**.

FIG. **10** shows a flow chart illustrating the performance of the surface-condition-changing roller **67**. The surface-condition-changing roller **67** stays on a position which is apart from the fixing belt **61** during the normal operation (during a printing job, for example). Therefore, the surface-condition-change controller **400** firstly drives the surface-condition-changing roller **67** to rotate after the starting operation in step S**51**, and the surface-condition-change controller **400** sequentially controls the surface-condition-changing roller **67** to contact with the fixing belt **61**, and the process proceeds to step S**53**. The fixing belt **61** is controlled so as to rotate constantly during the above operation. The surface-condition-change controller **400** controls the surface-condition-changing roller **67** to rotate during the time which is determined in step S**47***a* and step S**47***b* (refer to FIG. **9**). It is determined in step S**55** whether or not the above-described predetermined abutting time has elapsed, when the above time has elapsed, then surface-condition-changing roller **67** is separated from the fixing belt **61** in the following step S**57**, and the process is terminated by stopping the rotation. Thereby, because a surface layer of the surface-condition-changing roller **67** having a predetermined roughness contacts with the surface of the fixing belt **61** while the rotation, the linear scratch portion generated on the surface of the fixing belt **61** is abraded so as to expose a new surface of the fixing belt **61**. That is, the surface condition of the fixing belt **61** is changed. The changing degree depends on the rotating time of the surface-condition-changing roller **67**.

According to the above-described Embodiment, because the predetermined reference value which is used in the determination of the existence and non-existence of the scratch on the fixing belt **61** (fixing member) by the surface-information-detecting portion **300** is changed according to whether the surface of the fixing belt **61** has been abraded by the surface-condition-changing roller **67** once before or not (in other words, before/after abrading the fixing belt **61** by the surface-condition-changing roller **67**), the variation in level of the streak caused on the transfer paper S can be reduced. Eventually, the deterioration of the image which is formed on the transfer paper S can be prevented (equalization of the printed image quality can be managed).

In addition, the abrasion time of the fixing belt **61** (fixing member) by the surface-condition-changing roller **67** varies according to whether or not the fixing belt **61** has been abraded by the surface-condition-changing roller **67** at least once before or not, so the abutting time according to the level of the scratch can be selected appropriately. Accordingly, the minimum abutting time can be determined so that the level of the streak generated on the printed image is maintained at a certain level or less, and an operating life of the fixing belt **61** can be increased.

In addition, the reflective photosensor **200** can be arranged relatively free because it includes the detection area A in the parallel direction to the width direction of the fixing belt **61**. The surface information of the fixing belt **61** can be detected appropriately without influences caused by the characteristic variation or the installation variation of the reflective photosensor **200** because one reflective photosensor **200** is disposed corresponding only to the contact area W2, compared with the case in which a plurality of reflective photosensors **200** is used. In addition, the fixing belt **61** including a material having high surface hardness, such as PFA in the surface layer is easy scratched but the belt change or the like can be performed easily because the surface information thereof can be certainly detected through the reflective photosensor **200**.

The reflective photosensor **200** can detect at the same time the level and the position of the linear scratch caused by the contact between the transfer paper S and the surface of the fixing belt **61**. A plurality of LEDs **211** sequentially irradiates the fixing belt **61** in one direction of the width direction of the fixing belt **61** in the reflective photosensor **200**. In this instance, a crosstalk (a state in which one PD **212** receives a plurality of reflective light from the LED **211** at the same time) can be prevented compared with the case in which a plurality of LEDs **211** emits light at the same time, thus the accuracy of the detection result obtained according to each position of the light spot can be improved.

Herein, the configuration, controlling operation, or the like, of the apparatus described in the above Embodiment can be appropriately modified. For example, the surface-condition-change operation performed by the surface-condition-changing roller **67** can be configured according to an aspect as shown in FIG. **11**. In Modified Example as shown in FIG. **11**, when a printing job is terminated (image-formation process is terminated), the surface condition-detecting portion **300** drives the reflective photosensor **200** according to the flow chart as shown in FIG. **6**, and obtains a quantitative value while the fixing belt **61** is rotating in step S**61**. When the operation of the reflective photosensor **200** terminated, the surface-information-detecting portion **300** determines the existence and non-existence of the scratch on the fixing belt **61** in the following step S**63**. Similar to the above-described Embodiment, the determination criteria for determining the existence and non-existence of the scratch varies according to whether the fixing belt **61** has been abraded once before (it is not described in the present Modified Example and in FIG. **11**). When the detection result indicates the non-existence of the scratch (NO) as a result of the determination, the process of the surface-condition-changing control is completed without driving the surface-condition-changing roller **67**. On the other hand, when the existence of the scratch is detected on the fixing belt **61** (YES) by the surface-information-detecting portion **300**, the process goes to step S**65**, and the surface-condition-change controller **400** controls the operation of the surface-condition-changing roller **67** similar to the above-described case (refer to FIG. **10**). The operation time of the surface-condition-changing roller **67** varies according to whether the fixing belt **61** has been abraded once before, similar to the above-described Embodiment (the description is omitted in the present Modified Example and in FIG. **11**).

After the operation of the surface-condition-changing roller **67** in step S**65** is terminated, the process returns to step S**61** and the reflective photosensor **200** is operated so as to determine the surface condition of the fixing belt **61**. In order to control the above operation, as shown in FIG. **1**C, the surface-condition-change controller **400** is configured so as to control both of reflective photosensor **200** and surface-information-detecting portion **300**. Thereby, it can be confirmed whether or not the surface condition of the fixing belt **61** is changed to have the condition without any scratch. The reflective photosensor **200** can confirm not only the position of the scratch but also confirm whether or not the uniform condition without having a scratch is obtained for all of the irradiated areas. If the scratch still remains after the confirmation, the surface-condition-changing roller **67** is operated again and a series of the operation can be repeated until the linear scratch is disappeared. Thereby, the condition of the fixing belt **61** without any scratch can be certainly obtained. The condition without the scratch herein is sufficient if the condition of the fixing belt **61** is at the extent that the influence caused by the linear scratch is acceptable degree for the image quality. For example, the condition is achieved when the linear scratch becomes small to be buried in such a tiny scratch, and the scratch is no longer recognized as the linear scratch although the entire surface of the fixing belt includes tiny scratches.

The surface-condition changing operation can be performed according to an aspect shown in FIG. **12**. In Modified Example shown in FIG. **12**, a printing operation I is performed at first, and after terminating the printing job, another printing operation II is performed using paper having a different size in the main-scanning direction from the paper which is used in the printing operation I. In the present Modified Example, when the surface-information-detecting portion **300** receives an operation instruction of the printing job II from a higher order controlling device in step S**81** after the printing job of the printing operation I is terminated (process of image-forming is terminated), it is determined whether the length of the paper in the main scanning direction for use in the printing job II (paper II) is longer than the size of the paper used in the printing job I (paper I) in the following step S**83**. When the length of the paper II in the main-scanning direction is determined to be shorter (smaller in size) than that of the paper II in step S**83**, the operation is terminated without performing the surface condition-changing operation (starting the printing job II).

On the other hand, when the length of the paper II in the main-scanning direction is determined to be longer (bigger in size) than that of the paper I, the process goes to step S**85**, and the surface-information-detecting portion **300** drives the reflective photosensor **200** according to the flow chart shown in FIG. **6** for calculating the quantitative value. After the operation of the reflective photosensor **200** is terminated, the process goes to step S**87** so that the surface-information-detecting portion **300** determines the existence and non-existence of the scratch on the fixing belt **61**. Similar to the above-described Embodiment, the determination criteria of the existence and non-existence of the scratch varies according to whether the fixing belt **61** has been abraded at least once before (description is omitted in the present Modified Example and in FIG. **12**).

When the existence of the scratch on the fixing belt **61** is determined in step S**87**, the process goes to step S**89**, and when the non-existence of the scratch on the fixing belt **61** is determined (actually, the influence of the scratch is at the extent that it can be considered to have no problem with the printing quality), the operation is terminated without the surface-condition-changing operation (starting the printing job II). In step S**89**, the surface-information-detecting portion **300** drives the surface-condition-changing roller **67** so as to abrade the surface of the fixing belt **61**. The time for abrading the surface of the fixing belt **61** in this instance varies according to whether the fixing belt **61** has been abraded once before (description is omitted in the present Modified Example and FIG. **12**). Next, the reflective photosensor **200** is driven again in step S**91**, and it is determined whether the linear scratch that may cause a problem with the printing quality is generated on the fixing belt **61** or not according to the result in step S**91** in step S**93**. The reference value which is used in step S**93** for determining the existence and non-existence of the scratch is one value because it is obvious that the fixing belt **61** has been abraded before (in step S**89**). When the existence of the scratch on the fixing belt **61** is determined in step S**93** (the scratch is not resolved during step S**89** despite the performance of the surface-condition-changing roller **67**), the process goes back to step S**89** and the surface-condition-changing roller **67** is driven again. On the other hand, when the non-existence of the scratch on the fixing belt **61** is determined, the operation is terminated (starting the printing job II).

The surface-condition-changing operation on the fixing belt **61** by the surface-condition-changing roller **67** is not performed when the size of the paper which is used in the printing job II is smaller than that of the paper used in the printing job I (NO determination in step S**83**) in the above-described Modified Example according the flow chart shown in FIG. **12**. This is because the linear scratch formed on the fixing belt **61** when the printing is operated using paper having a large size (broad width) may not cause a problem upon a printing operation using smaller size (narrow width) paper. Because the need to perform the surface-condition-changing operation for the fixing belt **61** is determined according to the size of the printing paper in the present Modified Example, the efficiency is better than that in the case in which the reflective photosensor **200** is always driven so as to determine the existence or non-existence of the scratch.

In addition, as shown in FIG. **13**A, a plurality of light spots SP (detection position of the reflective photosensor **200**) is arranged on the fixing belt **61** along the parallel direction to the width direction of the fixing belt **61** (X-axis direction) in the above-described Embodiment. However, the configuration is not always limited to the above and it is acceptable if the light spots SP are arranged to cross the X-axis direction at 45 degrees as shown in FIG. **13**B, for example. The length of the detection area A' in the X-axis direction is shorter to be in $1/\sqrt{2}$ compared with the detection area A (refer to FIG. **13**A) but the arrangement interval of the light spots adjacent to each other can be reduced to be $1/\sqrt{2}$. Therefore, the position resolution of the detection result can be improved.

The detection as to whether the fixing belt **61** has been abraded at least once before is performed and the control operation to select two different reference values according to the detection result is performed in the above-described Embodiment. However, the configuration is not always limited to the above, and for example, it can be configured so as to abrade the surface of the fixing belt **61** after the fixing belt **61** is changed to a new one and the surface-condition-changing roller **67** is driven prior to the printing operation. In this instance, as shown in a flow chart in FIG. **14**, when the printing job is terminated (start), the surface-information-detecting portion **300** calculates the above-described quantitative value at the same time as it drives the reflective photosensor **200** according to the flow chart shown in FIG. **6** under the condition in which the fixing belt **61** rotates in step S**71**. Step S**43** (refer to FIG. **9**) in the above-described Embodiment is not necessary because it is certain that the fixing belt **61** has been abraded in the present Modified Example.

Next, the surface-information-detecting portion **300** determines whether or not the quantitative value obtained in step S**71** exceeds the predetermined reference value in step S**73**. The reference value used herein is a single reference value, which is different to that in the above-described Embodiment. Sequentially, similar to the above-described Embodiment, the process goes to step S**75** in which the surface-condition-changing roller **67** is driven so as to abrade the surface of the fixing belt **61** when the quantitative value exceeds the reference value. It is appropriate to change the driving time of the surface-condition-changing roller **67** during the above operation, similar to the above-described Embodiment, according to the level of the scratch with reference to the relationship table (function or list) which is prepared in advance. When the quantitative value does not exceed the reference value, the operation is terminated. According to the present Modified Example, the level of the streak on the printed image can be suppressed to a certain extent.

In addition, the fixing belt **61** can be abraded by the surface-condition-changing roller **67** without any influence from the linear scratch as a detection object when the surface of the fixing belt **61** is previously abraded by operating the surface-condition-changing roller **67** prior to the printing operation and after the fixing belt **61** is changed to a new one as described above. The output value of the reflective photosensor **200** herein is stored in a recording medium so that it can be used as criteria for determining the disappearance of the linear scratch in the process for detecting the linear scratch and abrading the detected scratch by the surface-condition-changing roller.

In addition, the surface-information-detecting portion **300** is configured to calculate a sum of the detection signal by the calculation every time as the surface-information-detecting portion **300** receives the detection result from a plurality of PDs **212** in the above-described Embodiment. However, the configuration is not always limited to the above. For example, it is also appropriate to configure a plurality of PD **212** to receive the reflective light corresponding to the timing of concurrent emission of the LED **211** because a plurality of LEDs **211** provided with the reflective photosensor **200** can emit light at one time. In this instance, it is also appropriate to configure the surface-information-detecting portion **300** not to calculate the sum of the detection signal but to obtain the reflective light intensity R_n in relation to the plurality of positions on the surface of the fixing belt **61** having intervals for each in the width direction using the detection result R_n through each PD **212**$_n$ which corresponds to each LED **211**$_n$.

In addition, the above-described Embodiment represents the case in which the surface information in relation to the linear scratch on the fixing belt **61** is the main object of detection but the detected result is not always limited to the above. The scratch which is made because of the offset as described above, thermistor, and/or contact with a peeling claw may be the detection object. For example, the deterioration in reflective light intensity R_n of the detected result is relatively low and is caused in a broad range in the offset case when the toner adhered on the surface of the fixing belt **61** has a film-like condition. The detection can be managed according to such a characteristic feature of the scratch in the offset. In addition, contrary to the fact that the width of the linear scratch is from about several hundreds of μm to about several mm, the scratch due to the thermistor or contact with the peeling claw is from about several tens of μm to about several hundreds of μm. Since the generating point of the scratch may be approximately fixed, such a scratch can be distinguished with the linear scratch through the detected position and the width of the scratch.

In addition, in the above-described Embodiment, the fixing belt **61** is used as the fixing member; however, the fixing member is not always limited to the above, and a fixing roller can be used instead.

In addition, in the above-described Embodiment, the surface-condition-changing roller **67** performs the abutting, separating, and sliding operation on the portion where the fixing belt **61** does not make contact with the fixing roller **64**. However, such an operation can be performed on the contacting portion between the fixing belt **61** and the fixing roller **64**.

In addition, the configuration of the reflective type optical detection device is not limited to the reflective photosensor **200** in the above-described Embodiment. It is also appropriate to configure the reflective type optical detection device so as to emit a plurality of light in the width direction of the fixing belt **61** and to receive the reflective light thereof. For example, the reflective photo sensor **200** includes a plurality of LEDs **211** and a plurality of PDs **211** which are arranged in an array so as to face each other one by one; however, it is not necessarily limited to the above configuration. The light deflection type arrangement in which the laser beam is polarized by a light deflector and one or more PDs receive the reflective light from the surface of the fixing belt can be used. Furthermore, a sensor-driving type reflective photosensor in which a light sensor configured by a single LED and single PD is moved in the width direction of the fixing belt **61** by a driver is also appropriate.

In addition, the configuration of the reflective photosensor **200** is not always limited to the above-described Embodiment. For example, it can be configured so as to include N (≥1) of LED **211** arranged in one direction, M (N≥M≥1) of lens which collects a light beam emitted from each of N LED **211** on the surface of the fixing belt **61** so as to configure the light spot, and K (N≥K≥1) of a photosensor which receives reflective light from the fixing belt **61** so as to form a light spot. In this case, a configuration of the condenser lens array can be simplified because one condenser lens is assigned for a plurality of LEDs **211**. In such a case, a photosensor which has a single light-receiving surface can be used. A condenser lens can also be used as a light-receiving lens in the photosensor if it is configured to be large in size.

In addition, in a transfer system in the color printer **100** in the above-described Embodiment, color toner image generated on each photosensitive drum **20**Y to **30**B is primarily transferred on the transfer belt **11** by the sequential superimposition, and the transferred color-toner image is transferred on the transfer paper S all at once by the secondary transfer roller **17**. However the transfer system is not always limited to the above. For example, it is appropriate that the system be such that the transfer paper S is held and sent on the transfer belt **11** so that the transfer paper S faces and makes contact with each photoconductor drum, and the toner image of each color is directly transferred onto the transfer paper S by the sequential superimposition from each photoconductor drum. In this case, the fixing operation of the color toner image in the above instance can be performed similar to the above-described Embodiment.

When the color printer **100** is configured so as to print several sizes of paper, such as A3, A4, A5, or the like, the maximum size of the paper capable of passing through the color printer **100** is A3. In most cases, the A3 paper is sent in the long side direction thereof. In this instance, the detection is performed on the surface information regarding the linear scratch on the transfer paper in all sizes except the A3-size. When it is supposed that A2 paper is capable of being sent through the color printer **100** in the long side direction, the detection is performed on the surface information regarding the linear scratch due to the transfer paper in all sizes except A2. In the description, if the A4 paper, for example, is sent in the long side direction, the width of the paper differs from the case in which the paper is sent in the short side direction even though it has the same A4 size. In such a case, it is determined that a plurality of sheet-like recording media each having a different size is sent.

According to the present invention, variations in image quality of a toner image which is fixed onto the sheet-like recording medium can be reduced.

The image-forming apparatus is a color printer in the above-described Embodiment, but the image-forming apparatus is not always limited to a color printer. For example, a monochrome copier, color copier, facsimile device, plotter device, or the like can be used, or a so-called MFP (Multi-Function Printer) can be also used.

Although the embodiments of the present invention have been described above, the present invention is not limited thereto. It should be appreciated that variations may be made in the embodiments described by persons skilled in the art without departing from the scope of the present invention.

What is claimed is:

1. A fixing apparatus for fixing a toner image borne on a sheet-like recording medium onto the sheet-like recording medium, comprising:

a fixing device relatively moving in a first direction with respect to the sheet-like recording medium, and having a surface in contact with the toner image during a fixing operation;

a photosensor configured to obtain surface information of the fixing device;

a surface-condition-changing roller arranged to abut on and separate from the fixing device, and abrading the surface of the fixing device in contact with the fixing device; and

a processing circuit configured to control an abutting and separating of the surface-condition-changing roller with respect to the fixing device according to a detection result of the photosensor, wherein

the processing circuit controls the surface-condition-changing roller according to the detection result of the photosensor with a criteria which varies before and after the surface-condition-changing roller abrades the fixing device.

2. The fixing apparatus according to claim **1**, wherein the surface information of the fixing device obtained by the photosensor is in relation to a depth of a linear scratch generated on the surface of the fixing device.

3. The fixing apparatus according to claim **1**, wherein

the processing circuit controls an abutting time of the surface-condition-changing roller with the fixing device according to the surface information detected by the photosensor, and

the abutting time, which is determined according to the surface information, varies depending on whether the detection of the surface information by the photosensor is operated to the fixing device including the surface which is abraded at least once by the surface-condition-changing roller.

4. The fixing apparatus according to claim **1**, wherein

the fixing device performs the fixing operation on the sheet-like recording medium of a plurality of sizes each having a different length in a second direction which is orthogonal to the first direction for each, and

the processing circuit controls the surface-condition-changing roller to abrade the surface of the fixing device when the size of the sheet-like recording medium is changed to a larger size.

5. The fixing apparatus according to claim **1**, wherein the surface-condition-changing roller abrades an entire contact area of the sheet-like recording medium and the fixing device in relation to a second direction, which is orthogonal to the first direction on the surface of the fixing device.

6. The fixing apparatus according to claim **1**, wherein the photosensor includes a reflective type optical device to irradiate the fixing device with a plurality of detection lights in a direction crossing the first direction, and to calculate the surface information of the fixing device according to reflection light of the detection light.

7. An image-forming apparatus comprising:

a developing device forming one or more toner images by an electrophotographic process;

a transfer device for transferring the toner image onto the sheet-like recording medium; and

the fixing apparatus according to claim **1** for fixing the toner image borne on the sheet-like recording medium to the sheet-like recording medium.

8. A fixing apparatus for fixing a toner image borne on a sheet-like recording medium, comprising:

a fixing device relatively moving in a first direction with respect to the sheet-like recording medium, and including a surface in contact with the toner image during a fixing operation;

a photosensor configured to obtain surface information of the fixing device;

a surface-condition-changing roller arranged to abut on and separate from the fixing device, and abrading the surface of the fixing device in contact with the fixing device; and

a processing circuit configured to control the abutting and separating of the surface-condition-changing roller with respect to the fixing device according to a detection result of the photosensor, wherein

after the surface-condition-changing roller abrades the fixing device at least once, the processing circuit controls the surface-condition-changing roller according to the detection result of the photosensor with a criteria in accordance with the detection result of the photosensor obtained after the surface-condition-changing roller abrades the fixing device.

9. The fixing apparatus according to claim **8**, wherein the surface information of the fixing device obtained by the photosensor is in relation to a depth of a linear scratch generated on the surface of the fixing device.

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